SERVICE TRAINING COURSE

BOOK NUMBER 2

MONROE

Models
LA * Function
LA-5 * Adjustment
LA-6
LA-7 * Nomenclature

GENERAL SERVICE DEPARTMENT
MONROE CALCULATING MACHINE CO., INC.

SERVICE TRAINING COURSE

Book No. 2

MONROE

ELEVEN SECTIONS

- DEVELOPMENT OF THE 'L' LINE
- IDENTIFYING FEATURES OF THE 'L' LINE
- THE 'A' AFTER THE 'L'
- COMPOSITE VIEWS & NOMENCLATURE
- INTRODUCTION TO INDIVIDUAL AUTOMATIC PARTS
- THE PLANETARY TRANSMISSION
- SELECTION AND CARRY-OVER PRINCIPLE
- KEYBOARD ACTION EXPLANATION
- WEDGE ACTION EXPLANATION
- CARRIAGE EXPLANATION
- CYCLE CONTROL MECHANISM

FOREWORD

Book No. 2 of this training course continues our study of
the small size Monroe calculators referred to generally
as the "L·Line". This term embraces models such as the
L, LN, LNX, LNE, LA, LA-5, LA-6 & LA-7 which make
up a large portion of our total calculator population. As
a serviceman in training, you should seriously apply your
time and efforts to learning all possible about this "L"
model calculator.   A complete understanding of the "L"
line will provide a foundation on which to build your know-
ledge of more complex models.   Questions left unan-
swered, in your mind, upon completion of Book No. 2 will
undoubtedly retard you when studying the more advanced
models. To become a good service technician, you must
first become a good student. The desire to learn is as
essential as having good material and using it properly.

The desire for, and the application of, knowledge gained
from this book, (No. 2) are your contributions to success
in your own career.
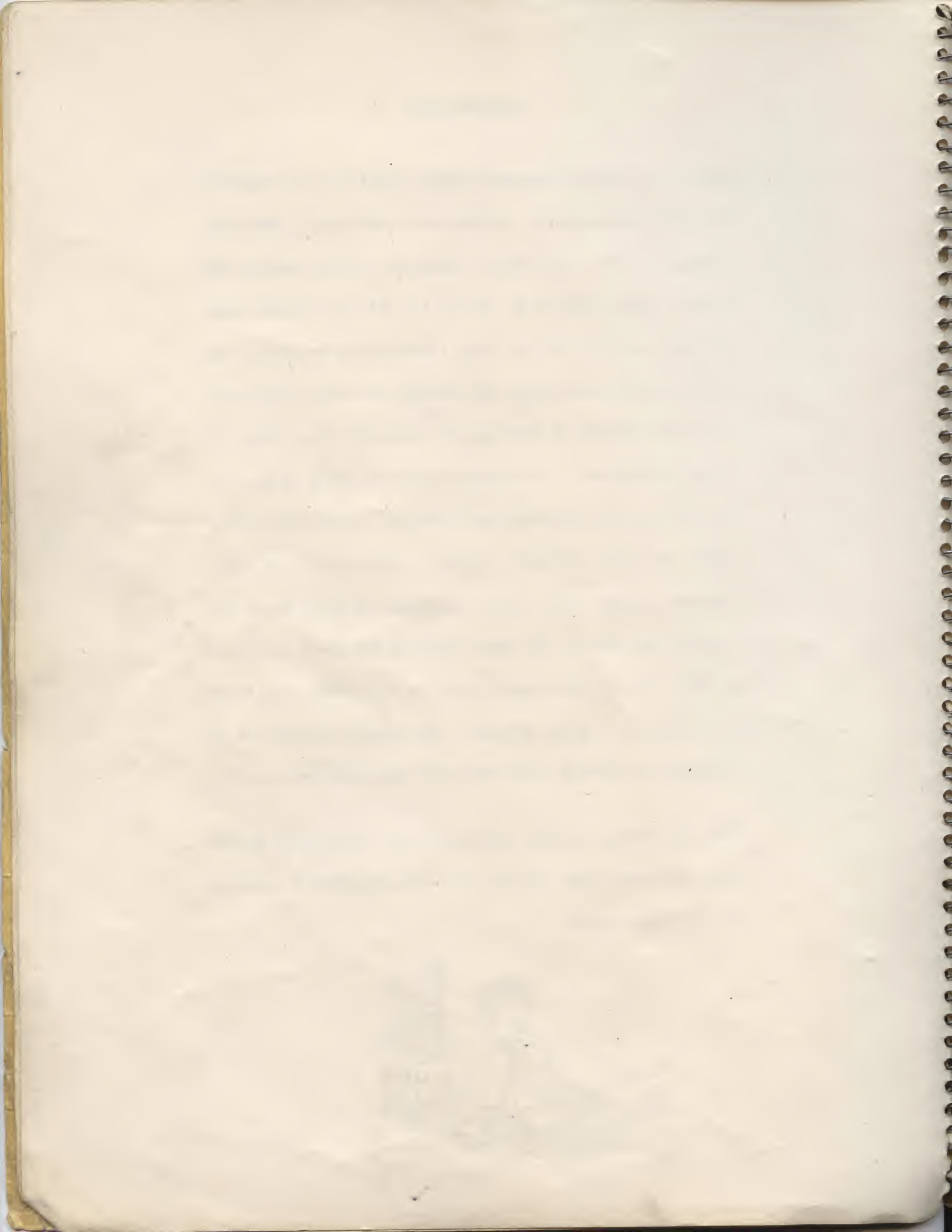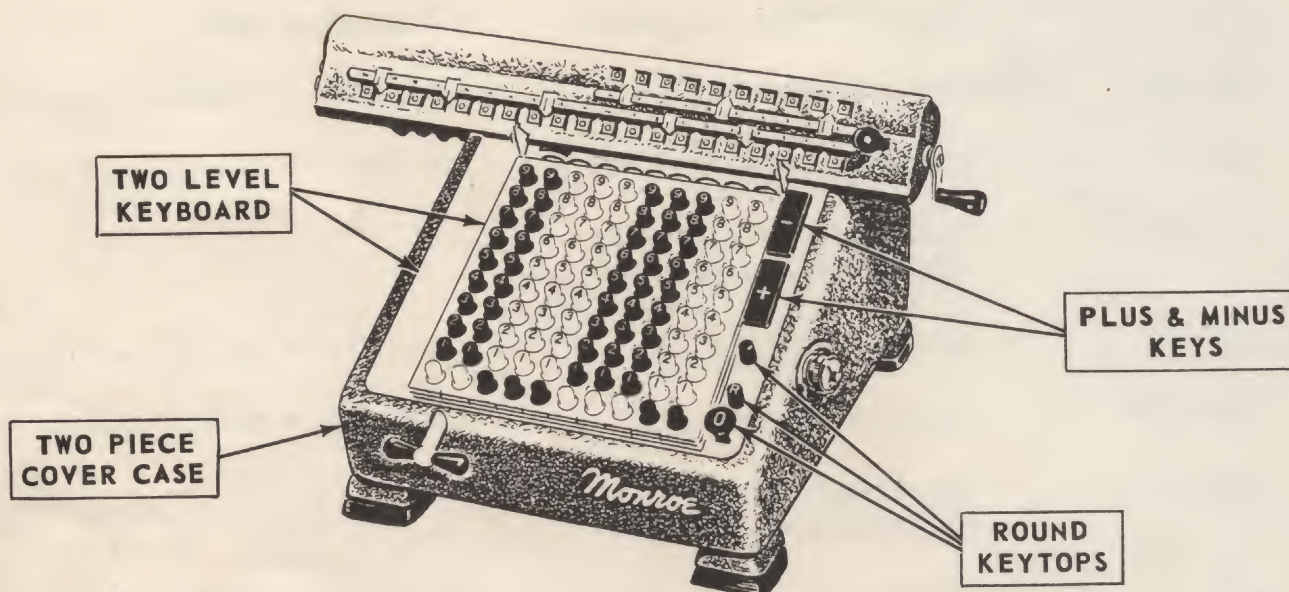
DEVELOPMENT AND FEATURES OF "L" MACHINES

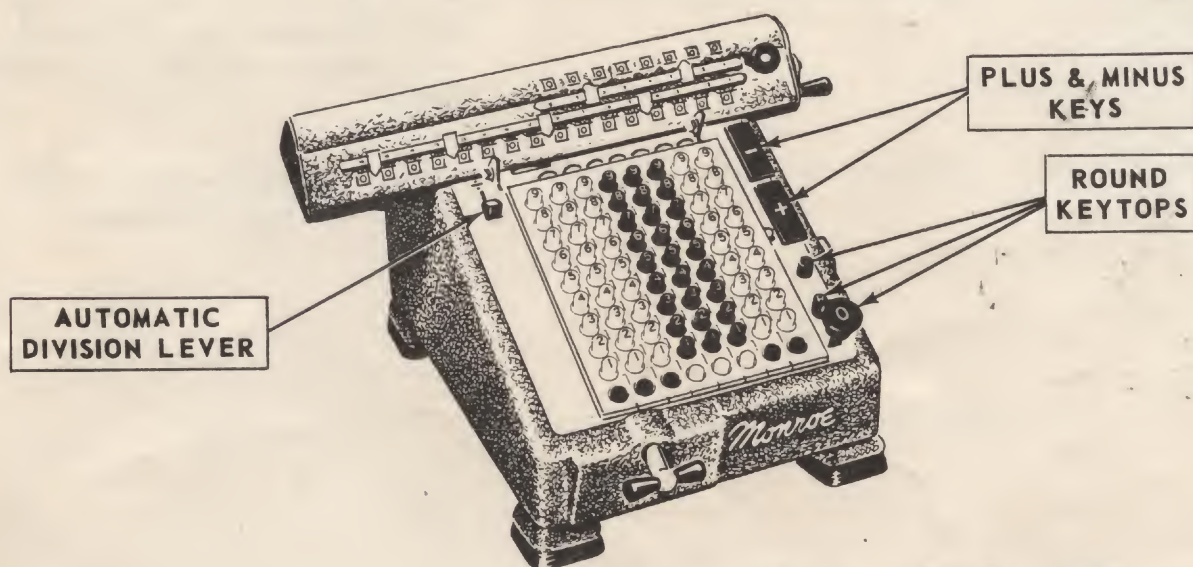| MODEL	PLUS	REVISION	BECAME MODEL
L	+	Supplementary keyboard	LX (folding legs)
LX-160	+	Revised exterior	LNX-160 * (folding legs)
LX-200	+	Revised exterior	LN-200 * (large case)
L-1207		No change up to time of discontinuance of model	
L-1307	+	Revised exterior	LN-140 * (large case)
LE-1307	+	Revised exterior	LNE-140 * (large case)
LA-1307		No change up to time of discontinuance of model	
LX	+	Motor	LA (electric model with plus and minus bars)
LA	+	Automatic division	LA-5 (automatic model with division lever and plus-minus bars)
LA-5	+	Automatic Multiplication	LA-6 (fully automatic of "L" line with automatic div. lever, mult. lever and plus-minus bars)
LA-5	+	Revised exterior	LA-7 * (auto. model with div. lever and plus-minus bars)

* = In production at present time

MONROE

TWO LEVEL
KEYBOARD

PLUS & MINUS
KEYS

TWO PIECE
COVER CASE

ROUND
KEYTOPS

The LA

PLUS & MINUS
KEYS

ROUND
KEYTOPS

AUTOMATIC
DIVISION LEVER

The LA-5

CONSTANT KEY

THRU-CARRY UNIT

AUTOMATIC DIVISION LEVER

TWO LEVEL KEYBOARD

TWO PIECE COVER CASE

AUTOMATIC MULTIPLICATION LEVER

ROUND KEYTOPS

REPEAT KEY CONTROL

The LA-6

PLUS & MINUS KEYS

RECTANGULAR KEYTOPS

AUTOMATIC DIVISION LEVER

SINGLE LEVEL KEYBOARD

ONE PIECE COVER CASE

DECIMAL KNOBS AT FRONT
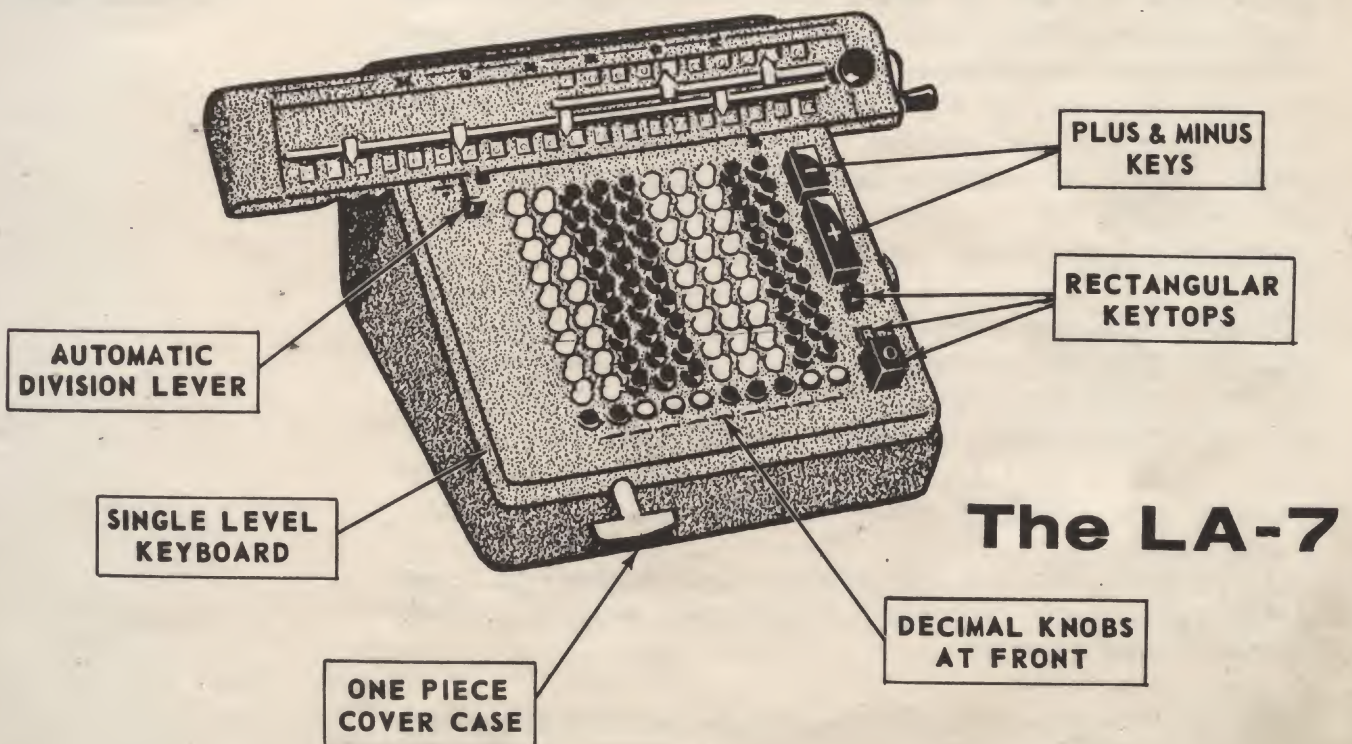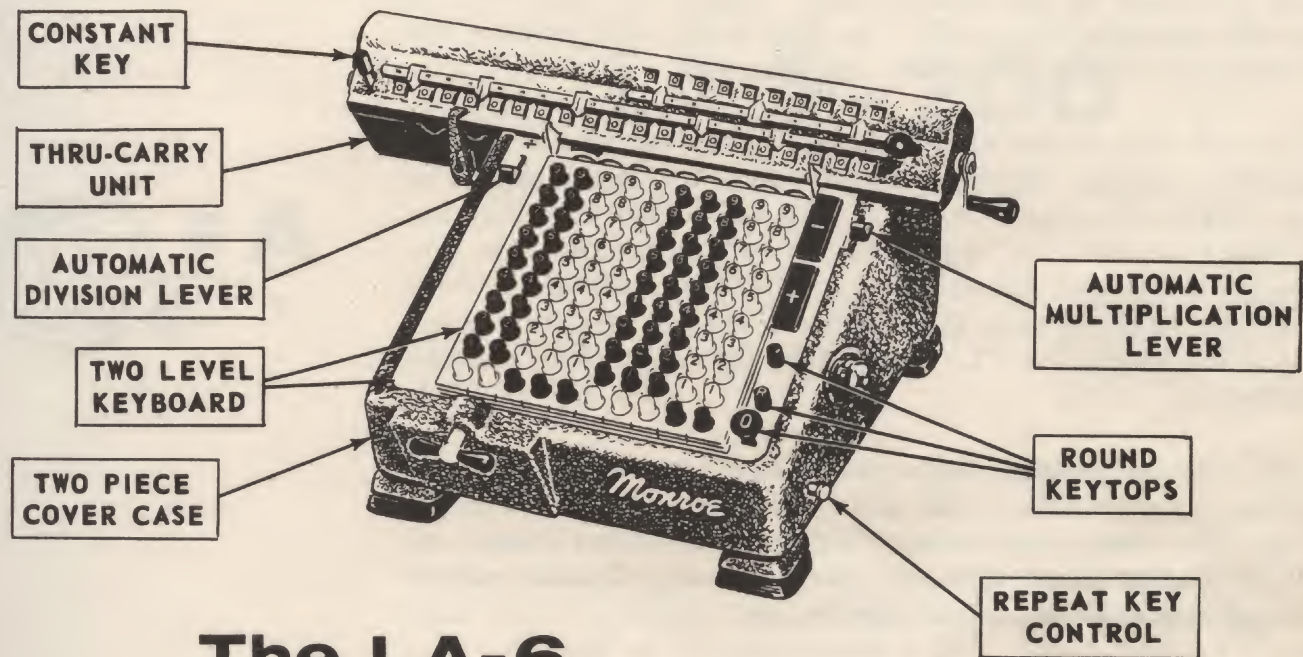
The LA-7

THE "A" AFTER THE "L"

Explanation of a Code

Thru the medium of Book Number I, you have learned the meaning of the letters and digits 'L-160-X'as a model identification code. In this book, we explain the coding of our LA automatic machines.

The LA is a small size Monroe calculator containing an electric motor which is employed to drive revolving or cycling mechanism. In the L-160 and L-200 models, the cycling mechanism is rotated (turned) by means of a machine hand crank which the operator turns either forward or rearward. From this, we can assume that the letter "A" following the "L" indicates "Electric" or "motor driven".

A =

The LA-160 model, therefore, is a motor driven machine, operated from the plus and minus bars. All computations must be initiated by these two bars (+ and -). This machine can also be operated with a hand crank in the absence of electrical power.

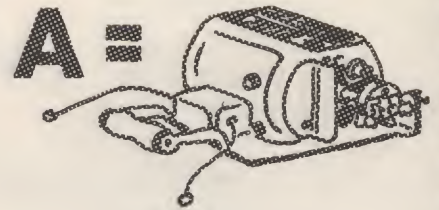

The speed of this machine is set at 380 R.P.M. (revolutions per minute). The speed setting is accomplished by turning a speed adjusting screw inward or outward to suit. This screw engages a contact point on the motor governor hinge plate. Thru centrifugal force, this plate is pivoted to make or break contact with the speed adjusting screw. This break in the feeding of electric current to the motor causes the motor to reduce speed. By depressing a keytop digit (#2) on the keyboard, (right hand columns), and timing 30 seconds with your wristwatch while the machine is cycling, the R.P.M. of the carriage dial will correspond to and indicate, the speed at which the machine's mechanism is cycling.

As with a car, excessive speed is not desirable.

The LA model contains approximately 12 major part assemblies that are not used in the "L" hand models. Most of these parts are used to control the starting and stopping of the machine's cycling movements.

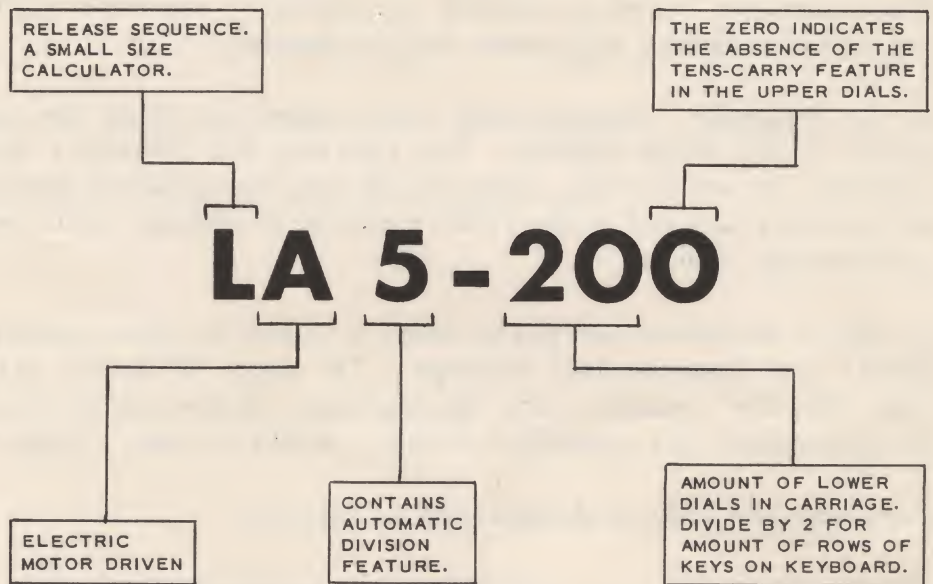

THE '5' AFTER THE 'LA'

We now know what LA represents. Let us move on to an explanation of the "5" which constitutes part of another model's identification.

This "5" indicates that the machine so identified contains automatic division.

| RELEASE SEQUENCE. A SMALL SIZE CALCULATOR. | | THE ZERO INDICATES THE ABSENCE OF THE TENS-CARRY FEATURE IN THE UPPER DIALS. |

LA 5-200

| ELECTRIC MOTOR DRIVEN | CONTAINS AUTOMATIC DIVISION FEATURE. | AMOUNT OF LOWER DIALS IN CARRIAGE. DIVIDE BY 2 FOR AMOUNT OF ROWS OF KEYS ON KEYBOARD. |

The automatic division mechanism is comprised of approximately 12 additional parts which are not used in the LA model. Only one of these parts is visible to the operator of a cased machine, namely the division lever. This lever extends upward through a slot in the upper L.H. corner of the keyboard plate. When moved fully toward the rear of the machine, this lever actuates a part known as the "Clutch Yoke", one of the most important parts of the entire mechanism. This "Clutch Yoke" initiates a sequence of mechanical movements causing the motor to start and the various shafts to cycle. Many of the 12 parts that make up the "5" automatic mechanism are used to provide an automatic shift of the carriage when such a shift is required during automatic division.

THE '7' AFTER THE 'LA'

This digit "7" is used to indicate that the exterior of this model differs from that of the LA-5 model. The internal mechanism of the LA-7, however, is identical to that of the LA-5. Because of this, the serviceman who studies and becomes familiar with the LA-5 can service the LA-7 without any difficulty. In view of the very large amount of LA-5 machines in use in the field, it is obvious that Servicemen will come in contact with the LA-5 as often as they will the LA-7 model. It naturally follows that a study of LA and LA-5 mechanism will serve varied purposes and our book will be written with these as our main points of interest.

PART NUMBERS

Part numbers used to identify mechanism are meaningful, and an understanding of their coding will prove helpful to you.

As an example, suppose you were asked to count the amount of part #2582 in stock in the parts cabinet. You find that the container bearing this part number contains 20 set screws. How would you immediately know that these screws are incorrectly located in the #2582 container; without referring to a parts catalog or questioning others?

To those who know our parts code, it would be immediately apparent that the container was provided for springs. The digit "8" in the part number provides the clue that the container was for springs. If the set screws were to be stocked in the container, the container number would include a digit "6" instead of the "8".

Part number 2582 is deciphered as follows;

BLOCK I	BLOCK II	BLOCK III IV V
2	5	8 2
L MODEL	CARRIAGE	SPRING

#2582 is a spring used = in the carriage of an "L" line machine.

BLOCK I	BLOCK II		BLOCK III, IV, V
MODEL	SECTION OF MACHINE	CODE	MANUFACTURE CATEGORY
Even Number = ½" Keyboard spacing	Keyboard	1	000 to 049 = Shafts
Odd Number = 5/8" Keyboard spacing	Selecting Shaft	2	050 to 349 = Punch Press Parts
	Wedge Shaft	3	350 to 499 = Collars, Bushings
	Carry Shaft	4	500 to 749 = Studs
	Carriage	5	750 to 789 = Gears
	Side Frames & Connections	6	790 to 799 = Castings
	Auto Mechanism	7	800 to 899 = Springs
	Carry Counting	8	900 to 999 = Plastic, Misc., & Commercial
	Auto Mechanism	9	

Even numbers "2" and "4" in Block I indicate an "L" part.
Even number "6" indicates a "C" and "N" part.
Odd numbers "3" & "5", indicate a M, MA, MA 3, 4, 5, 6, 7 or AA1 part.

SECTION **ABC** QUESTIONNAIRE

STUDENT _____ BRANCH _____ DATE _____

ORANGE EXAMINER _____ RIGHT _____ WRONG _____

1. Q. What external difference is there between an LA-5 and an LA-7 model?

   A.

2. Q. What major internal difference is there between these models?

   A.

3. Q. What models have folding legs?

   A.

4. Q. What force is employed by the governor to control R.P.M.?

   A.

5. Q. How does LA mechanism differ from LA-5 mechanism?

   A.

6. Q. In block form, below, decode part number 2337. After doing so, consult page 30 of Machine Service Bulletin #490 and check your deciphering against the illustration of this particular part.

   A.

7. Q. What does the letter "N" represent when used following the "L" in a model designation?

   A.

8. Q. Approximately how many more major parts are used within the LA-5 than in the LA model?

    A.

9. Q. Approximately how many more major parts are used within the LA than in the L?

    A.

10. Q. What model has a single-level keyboard?

    A.

11. Q. What model has a thru carry unit?

    A.

12. Q. Why does the LA-5 have a different clutch yoke than the LA?

    A.

13. Q. What shaft is coupled to, and drives the rock lever—connecting link?

    A.

14. Q. Does a composite view have any value to you? In what manner?

    A.

15. Q. What is meant by a shadow ring? What value does it have?

    A.

COMPOSITE VIEW LA-MODEL

Shown above is a composite view of the L.H. side frame mechanism of an LA machine. The bell has been eliminated from the drawing to permit a better view. Here you see the basic cycling control mechanism of the LA model which is also common to the LA-5, LA-6 and LA-7 models. This mechanism is put into motion by depression of the plus and minus keys. Removal of pressure from the keys stops the cycling motion. Details of how this mechanism starts and stops the cycling of the machine will be found on pages I-M through II-M herein.

NOMENCLATURE INDEX

27-100x1e	Keyboard	27-794x2a	Motor Unit
27-400x2	Main Carry Shaft	40-300x1	Intermediate Gear & Wedge Shaft
27-715x3a	Clutch & Jack Shaft	40-774x1a	Machine Stopping Lever
27-723x2a	Outer Transmission Plate	40-7129	Clutch Yoke Pos. Click
27-770	Rock Lever & Connecting Link	41-714x1	Switch Closing Arm
27-780x1a	Quick Stroke Latch	41-797x1a	Start & Stop Switch
27-781x3	Clutch Yoke	57-760x1	Locator Arm

TRIP LEVER

ROCK LEVER and CONNECTING LINK

DIVISION LEVER

BUMPER

MACHINE STOPPING LEVER

TRANSMISSION

SHIFT DRIVING LEVER

CLUTCH YOKE

CYCLE STOP ARM

POSITION HOLDING ARM for Clutch Yoke

MACHINE LOCATOR ARM

POSITION HOLDING ARM for Division lever

QUICK STROKE LATCH

COUPLING ARM

SHIFT COUPLING LATCH ARM

AUTOMATIC SHIFT ARM

CARRY
SHAFT

HINGE ROD
BRACKET

JACK
SHAFT

DUAL LOCATOR
CAMS

WEDGE
SHAFT

FRICTION
CLUTCH

CARRIAGE
BRACKET

CARRIAGE
LOCK

NON-REPEAT
KEY

CRANK
LATCH

REPEAT
KEY

CLEAROUT
KEY

MOTOR

MOTOR
JACK

PLUNGER

GOVERNOR

ROCKER

PLUS KEY

MINUS KEY

CAM LOCATOR
ARM

SPEED SCREW
BRACKET

NON-REPEAT
CLEAR LEVER

GEAR
TRAIN

ROCKER
ARM

(7 GEARS)

CROSS FRAME

SELECTING BAILS

REPEAT KEY

HAND CRANK
CUT-OUT ROD

NON REPEAT
KEY

PLUS-MINUS
ROCKER LATCH

RESISTOR

PLUS KEY

CLUTCH YOKE
POSITIONER

MINUS KEY

TRANSMISSION

L.H. SIDE
FRAME

MOTOR SUPPORT
CROSS PLATE

R.H. SIDE
FRAME

MOTOR GOVERNOR

CARRIAGE NOMENCLATURE

CLEAROUT CRANK

INTERMITTENT GEAR

DRIVE GEAR

LOCKING FINGER

LOCKING FINGER
WITH SPRING DETACHED

DRIVE GEAR

PLUNGER PIN

PLUNGER PIN

LIFT CAM SHAFT

REGISTERING DIAL SHAFT

COUNTING DIAL

REGISTERING DIAL

TRIP ROD

CARRIAGE LIFT CAM

TRIP PAWL

COUNTING DIAL SHAFT

LOCATOR YOKE

ROCKING CAM

ROCKING CAM

LOCATING FINGERS

SHELL

AUTOMATIC MECHANISM PARTS LA-MODEL

TRIP LEVER

This lever is tripped (rocked) when engaged by a stud on
a registering dial. In doing so, a lug on the trip lever
lifts an associated flexible arm. The lifting of this arm
actuates a coupling latch on the

FLEXIBLE ARM
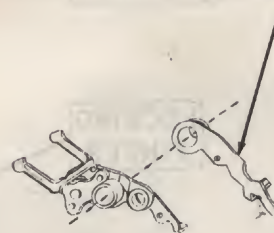
CYCLE STOP ARM

This arm upon actuation of its drive coupling latch will
be driven forward to a bumper movement limiting brac-
ket. In doing so, the lower section of the arm containing
an aperature actuates a positioning stud on the clutch
yoke. This arm also causes the quick stroke latch to be
rocked into active position.
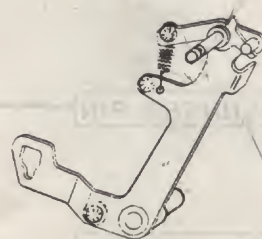
MACHINE STOPPING LEVER

This lever raises the trip lever flexible arm upon re-
lease of pressure from the plus and minus keystems due
to being spring loaded by a
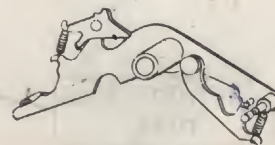
QUICK STROKE LATCH

This latch drops over a step of the machine stopping le-
ver. It is actuated by the cycle stop arm.
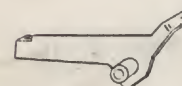
ROCK LEVER AND LINK

The link drives the cycle stop arm to the bumper pad fol-
lowing a trip.

LOCATOR ARM

This arm moves upward to block the path of the rock le-
ver and locate the cycling mechanism in neutral.

AUTOMATIC MECHANISM PARTS LA-5 MODEL

AN INTRODUCTION TO THEIR PURPOSE

DIVISION LEVER

The top of this part extends through a slot in the key-
board. When the lever top is pushed toward the rear of
the machine, the stud on the bottom moves the clutch yoke
into minus position. At the completion of a division prob-
lem, this lever is automatically restored to neutral.
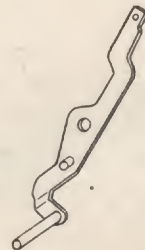
POSITION HOLDING ARM

This part holds the division lever securely in its two po-
sitions. This part is adjustable.

SHIFT DRIVING LEVER

This lever is attached to a post on the cycle stop arm.
When it moves toward the front of the machine during
automatic division, it engages the roller on the

SHIFT COUPLING ARM

This arm relays the motion of the shift driving lever to
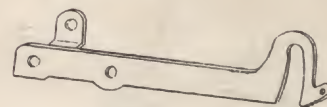the

SHIFT COUPLING LATCH ARM

This part controls the latching of itself with the coupling
arm depending on the raising or lowering of the division
lever position holding arm.

AUTOMATIC SHIFT ARM

This part is driven downward sharply during automatic
division by the coupling latch arm which in turn pulls down-
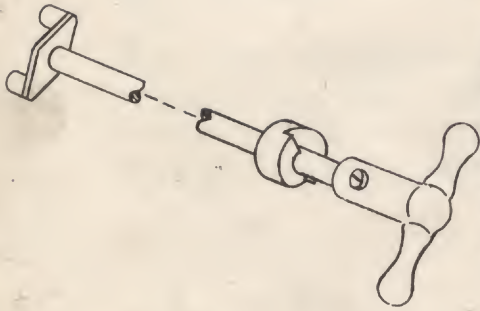ward on the

SHIFT CAM LEVER

This part, when rocked by the shift arm, causes its roller
to move upward sharply and actuate a shifter drive cam.

AUTOMATIC MECHANISM PARTS LA-5 MODEL

## AN INTRODUCTION TO THEIR PURPOSE

SHIFTER

This is the carriage shifter, which, during automatic division operation will cause the carriage to move to the left. The two rollers engage scallops of the carriage and drag the carriage sidewise during both manual and automatic operation of the shifter rod. The cam causes the rod to turn automatically during division. The handle is used for manual shift of the carriage.

SHIFT CAM

This cam moves into mesh with the cam on the shifter rod when the division lever is moved into operating position. An upward movement of the shift lever causes a roller on the lever to whip the shift cam upward, thereby causing the shifter rod to turn.
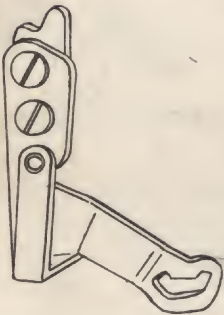
CLUTCH YOKE EXTENSION ARM

This is the extension arm of the clutch yoke which serves as the actuating means for moving the clutch yoke from minus to plus (and vice-versa) during automatic division.

TRIP ENGAGING ARM

This part engages and moves the clutch yoke extension arm into latched position when the division lever is moved into operating position. It has an adjustable stud by which positive latching is assured.

AUTOMATIC MECHANISM PARTS LA-MODEL
AN INTRODUCTION TO THEIR PURPOSE

CLUTCH YOKE

This part blocks sections of the transmission by being pivoted into an upward or downward position by the plus and minus keys or the division lever. It thereby causes the machine to reverse the direction of its cycling mechanism.

MINUS FINGER

LA MODEL CLUTCH YOKE

PLUS FINGER

MINUS FINGER

PLUS FINGER
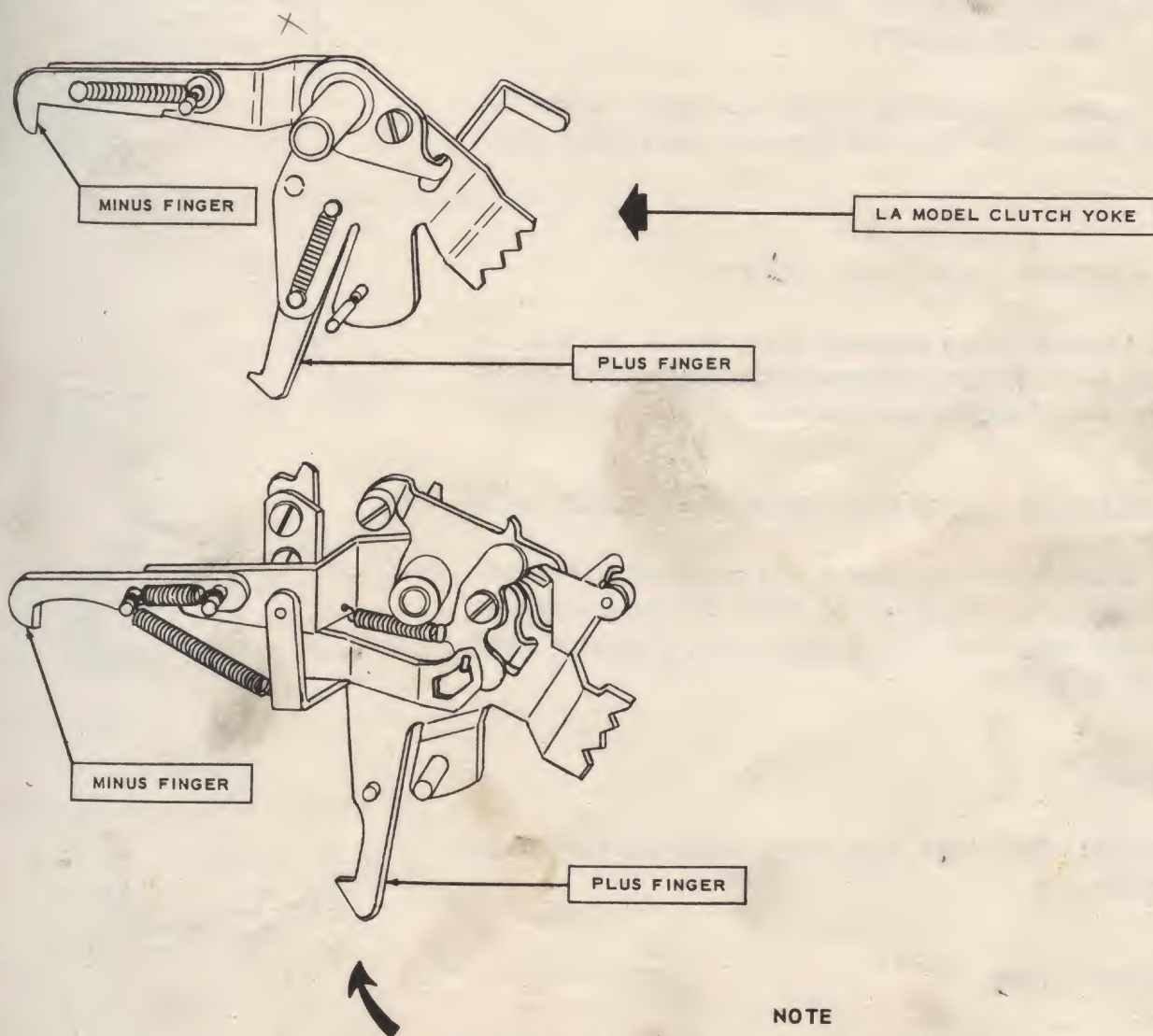
NOTE

The Clutch Yoke used in LA-5 and LA-6 and LA-7 machines looks like this. Its automatic parts permit this yoke to be rocked into plus and minus positions without use of the Plus and Minus Keystems.

AUTOMATIC MECHANISM PARTS LA-6 MODEL

### AN INTRODUCTION TO THEIR PURPOSE

MULTIPLICATION LEVER

Movement of the upper part of this lever toward the rear
of the machine will cause the lower section to set up the
automatic mult. mechanism.

MULTIPLICATION-DIVISION LEVER
CONTROL LINKAGE SHAFT

This part causes a latching of the multiplier slide as-
sembly and places the division lever in operating posi-
tion.
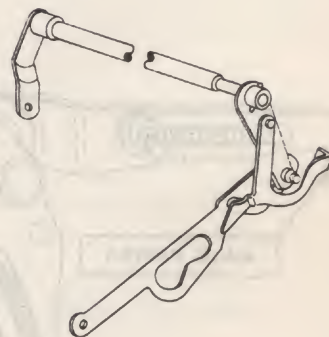
MULTIPLICATION TRIP ARM SHAFT

This shaft transmits an impulse from the R.H. side to
the L.H. trip lever during automatic multiplication when-
ever a reversal of cycle is required.

MULTIPLICATION CARRIAGE ENGAGING SLIDE ARM

This arm, when latched upward, will receive a trip im-
pulse from the R.H. registering dials during automatic
multiplication and relay it via the mult. trip arm shaft
to the L. H. trip lever.
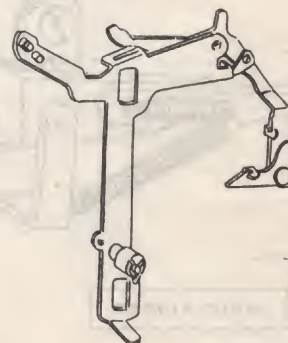
SLIDE LATCH

This part holds the slide arm upward during automatic
multiplication.

THRU-CARRY UNIT

This unit provides the solution to certain arithmetical
problems more quickly and with less motions on the part
of the operator. You, as a serviceman, will notice that
the unit furnishes a carry-over for registering dials
that otherwise would be inoperative during certain prob-
lems. Without this carryover, incorrect lower dial read-
ings might possibly be obtained in some calculations.
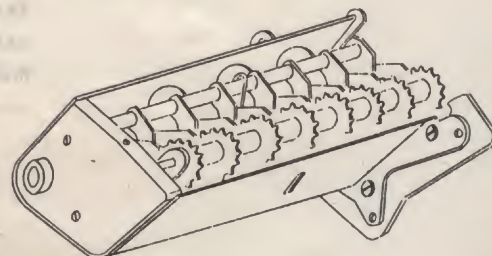
SECTION D & E QUESTIONNAIRE

STUDENT _____ BRANCH _____ DATE _____

ORANGE EXAMINER _____ RIGHT _____ WRONG _____

1. Q. Which model is equipped with a bell as standard equipment?

   A.

2. Q. What is a gear train?

   A.

3. Q. How many gears comprise the R.H. gear train?

   A.

4. Q. How many locator arms, identified as such, are used on the LA-5 model?

   A.

5. Q. How many 4-side selecting bails are used in an LA-160 machine?

   A.

6. Q. In what unit of the LA-5 machine are trip pawls used? Why?

   A.

7. Q. Why do you think dual locator cams are used on the R.H. side of the machine?

   A.

8. Q. What is the purpose of the aperture in the cycle stop arm?

   A.

9. Q. What three "L" models contain the automatic division feature?

   A.

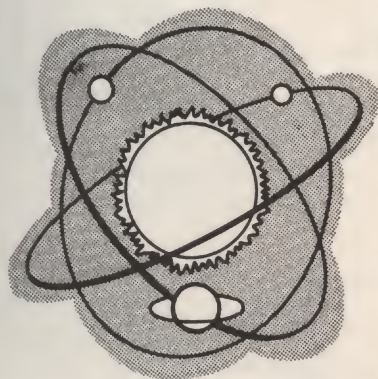10. Q. What part or parts, engage or are engaged, by the quick stroke latch?

    A.

11. Q. What is the main action performed by the division lever when moved into operating position?
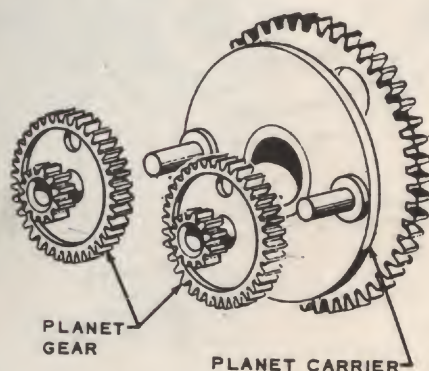
    A.

THE TRANSMISSION
Gears That Change Direction

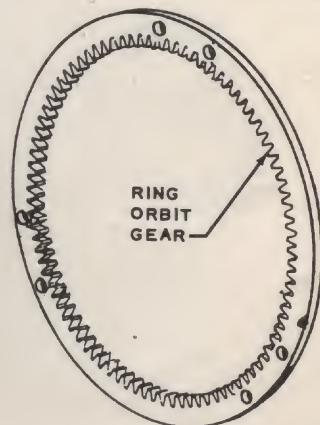NATURE'S PLANETARY SYSTEM

SUN DRIVING PINION

PLANET GEAR

PLANET CARRIER

RING ORBIT GEAR

The armature of the motor of our automatic machines was not designed to run forward and rearward at the constant and immediate dictate of the cycling mechanism. Because of this fact, a unit of six gears known as "the transmission" is used to enable the gear train of the machine to be reversed when required. Our transmission is of the "planetary" type and it is controlled by a dual fingered part known as the "clutch yoke" of which you previously studied. A lowering or raising (pivoting) of this clutch yoke will retard different sections of the transmission and thus cause the selecting and main carry shafts of the machine to rotate clockwise for addition and multiplication or counter-clockwise for subtraction and division (viewed from R.H. side). A planetary transmission has been used continuously in Monroe Calculators for 34 years. The name "Planetary" is derived from the celestial bodies (planets) that revolve about the Sun of our solar system. Recent world news of the success of a man-made satellite (a secondary planet) has caused a surge of interest in the word "Planetary". The automobile industry, a few years ago, reinstated usage of "Planetary" transmissions on a large scale for automatic or semi-automatic car transmissions. This new popularity occurred after their usage had virtually disappeared from automobiles. Planetary gears can be made to do a number of different things according to how we connect them into the power system. We, at Monroe, use it mainly for reversing our drive.

The center of our Monroe planetary transmission is occupied by a "SUN" driving pinion (2939x1a sun pinion).

This small pinion, when coupled to the motor shaft, drives the two "planet" gears with which it is constantly in mesh.

The planet gears are in constant mesh with internal teeth of a ring "orbit" gear.

The planet gears are supported by, and rotate on, two horizontal posts fastened to a rotatable planet carrier.

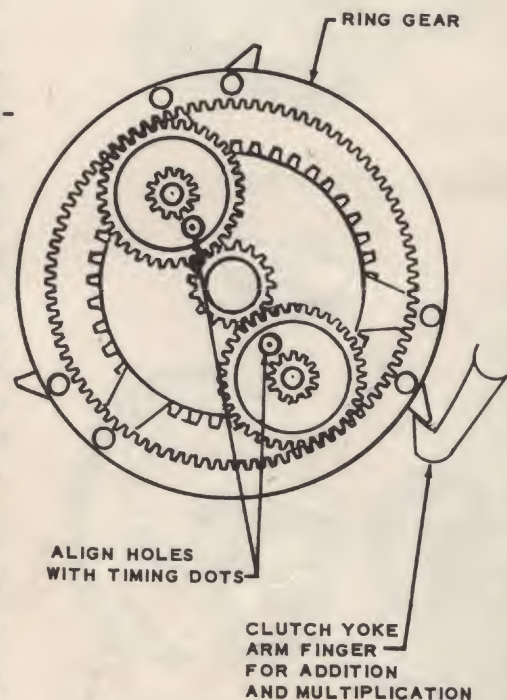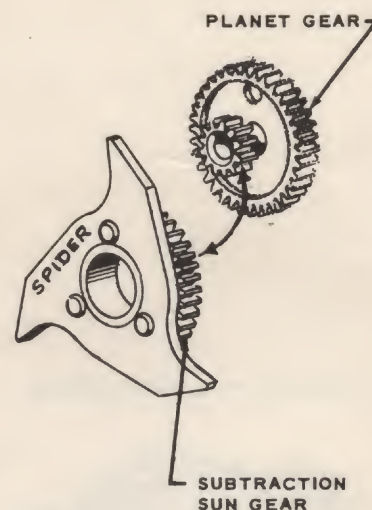The posts hold the planet gears in place, but also permit them to rotate.

From the foregoing, it can be seen that our Monroe planetary transmission is, in its simplest form essentially five gears. There is a SUN pinion in the center. Then there is a larger PLANET gear meshing with it. We use two planet gears. A subtraction sun gear is used in constant mesh with a small driving gear on the hub of the sleeve of the planet gear. On the outside, we employ a ring (orbit) gear, whose internal gear teeth mesh with the outer teeth of the planets.
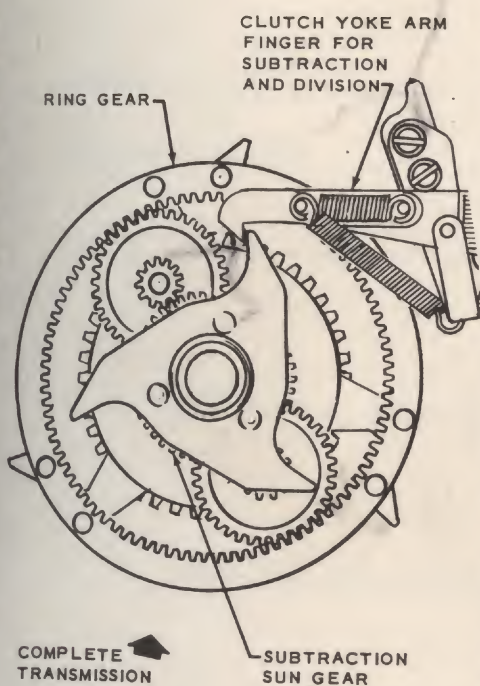
On the Monroe calculator the sun gear is connected to the power input (the motor drive shaft). The planet carrier is connected to the power output, a gear which in turn drives the slip clutch jack shaft clockwise or counter-clockwise.

Let us supposedly hold the outside of the ring orbit gear tightly by blocking it's path with a steel finger or by holding it with pliers so it cannot move. At this time, if the motor drives the sun pinion, the planet gears must turn around. However, these planet gears cannot remain in one position and merely rotate on their posts because that would mean that the ring orbit gear must move, but remember, we are holding the ring gear from moving with a steel finger or with pliers. Because of this, the planet gears must roll around the inside of the ring gear and, as they do, they force the planet carrier to move with them in a counter-clockwise direction. (From the L.H. side)

There are two motions to the planet gears. (1) Each planet is rotating about its own shaft, (2) while turning on its own shaft, they are also moving around in a circle on the teeth of the ring gear. This is where this type of gearing gets its name. The motion may be compared to the movement of the Earth and other planets about the sun; each one rotating on its own axis, but also continually circling around the sun.

The planet carrier and its power output gear is turning considerably slower than the sun gear and motor. The planet carrier rotates in the same direction at this time as the motor armature (drive shaft). The sun pinion always rotates in a counter-clockwise direction (looking from L.H. side of machine).

CLUTCH YOKE ARM
FINGER FOR
SUBTRACTION
AND DIVISION

RING GEAR

COMPLETE
TRANSMISSION

SUBTRACTION
SUN GEAR

Now, suppose we release our imaginary hold on the ring orbit gear and do not block the subtraction spider. (This can be done by making the clutch yoke inactive and then starting the motor. All of the gears will turn freely. Because of this, the planet carrier is NOT moved. Because the carrier is stationary, the machine gear train remains motionless.

If we "supposedly" held the spider of the subtraction sun gear tightly with a steel finger, we would find that the whole transmission (excepting the spider and subtraction sun gear) rotates as a single unit and causes the planet carrier to rotate clockwise (counter to the sun pinion). This in turn drives the gear train in a minus direction.

The transmission described herein is used in all automatic Monroe Calculators including those in current production such as LA 7, "C" and "N" lines. Because of this fact, it is well that you gain a full understanding of its function at this time. Although it has no adjustable parts of its own, except timing dots for aligning the planet gears, it is a vital part of our machine and is worthy of study. It should be noted at this time that the torque of the planet gears is greater than that of the sun pinion which also means that the planet carrier revolves at slower speed than does the motor.

The governor speed adjustment screw, of which you have read in a previous chapter, controls the motor speed close to 2400 R.P.M., but the planet carrier delivers only 380 R.P.M. to the machine shafts. In other words, we reduce the speed by 1 to 6, but increase the torque accordingly. TORQUE is another word for the 'twisting' or driving force applied to a shaft.

Through use of the Planetary transmission, we obtain the following:

1.   A means of reversing direction of rotating mechanism.

2.   Reduced machine cycling speed.

3.   Increased torque to drive the cycling members of the machine.

STUDENT _____ BRANCH _____ DATE _____

ORANGE EXAMINER _____ RIGHT _____ WRONG _____

1. Q. How many gears are included in the Monroe transmission?

   A.

2. Q. What drives the subtraction sun gear?

   A.

3. Q. What drives the sun pinion?

   A.

4. Q. From what does this gear unit derive its name?

   A.

5. Q. What is the planet carrier?

   A.

6. Q. Name the components of the transmission.

   A.

7. Q. Can the transmission gears turn without moving the carrier?

   A.

8. Q. If the motor rotates at 2400 RPM, what should the carriage dials RPM be?

   A.

SELECTION AND CARRY-OVER
# PRINCIPLE

SELECTION AND CARRY-OVER
PRINCIPLE

The selector bails of which there are two types, namely "four-side" and "five-side", rest on pivot studs (J), and when in neutral position stand upward due to the action of selector gear springs (H) holding the selector gears apart, in their neutral positions on the splines of the shaft. When the selector gears are apart in neutral position the machine can cycle without displacement of the registering dials. The counting dials, however, will register each cycle of the machine regardless of the selector gears position. The depression of a numeral keystem of the keyboard will cause either a "four-toothed" or a "five-toothed" selector gear, or both, to move toward the other a limited distance until the operative bail lug comes to rest in a notch in the bottom of the keystem. The angle of the lug on the selector bail determines how far the selecting gear will be moved sidewise when the keystem is depressed. The desired alignment of the selector gear teeth in relation to the intermediate gear is a 3/4 engagement of the intermediate gear teeth. If the alignment is "shy", the angle of the lug should be increased as shown in Figure 1. If the alignment, however, is "too-full", the angle should be decreased as shown in Figure 2. The two extensions (F) of the bails should engage the selector gear simultaneously to prevent a bind. For each column of keystems there is a pair of selecting bails beneath; one a "four-side" bail and the other a "five-side" bail. Keystems 1 to 4 actuate only the "four-side" bail, keystem 5 engages only the "five-side" bail and keystems 6 to 9 engage both bails. NOTE: The end play of the complete selecting shaft is controlled by turning the knurled cap on the L.H. end of the shaft with the fingers to obtain a minimum shaft end play movement without causing the shaft to bind.

The depression of numeral keystem, digit "5" (Figure 1) causes a camming surface on the bottom of the keystem to engage a lug (G) on a "five-side" selecting bail and pivot the bail inward on pivot studs (J). Two extensions (F) of the bail rest against the outer surface of a selecting gear and through this pivoting motion causes the 5 toothed selecting gear to move inward and into alignment with the intermediate gears of the wedge shaft. The selecting gear presents its five teeth to the intermediate gear (E) when the machine cycles.

When any keystem below digit "5" is depressed, a lug on a "four-side" bail is engaged pivoting the bail inward which in turn aligns the 4 toothed selecting gear with the intermediate gear. The selecting gear presents one to four of its teeth, corresponding to keystems depressed in keyboard, when the machine cycles.

When any keystem above digit "5" is depressed, both camming surfaces on the bottom of the keystem engage lugs of both "four-side" and "five-side" bails. This causes both four toothed and five toothed selecting gears, held in position by check spring (H), to be aligned with intermediate gears of the wedge shaft. Six to nine teeth of the selecting gears are presented to the intermediate gear when the machine cycles.

Due to the gear of the registering carriage dial being in mesh with the intermediate gear when the carriage is locked downward in position, the turning of the selecting gears will cause a tooth displacement of the registering dial corresponding to the keystem numerals depressed on the keyboard. Therefore, depression of the plus key with a "2" on the keyboard should result in a "2" appearing in the registering dial window of the same column and a "1" in the counting dial. The counting dial count is obtained through use of a counting finger driven from the carry shaft. If the plus key is again depressed, a "4" should appear in the registering dial and a "2" should appear in the counting dial. If the minus key is depressed with keyboard keys depressed and with a factor set in the registering dials, a subtraction would occur equal to the digits depressed in the keyboard. In other words, if "4" appears in a registering dial and a "2" is set in the keyboard and the minus key is depressed, it will cause a "2" to be subtracted from the registering dial "4".

Figure 1

Figure 2

Figure 3

Figure 4
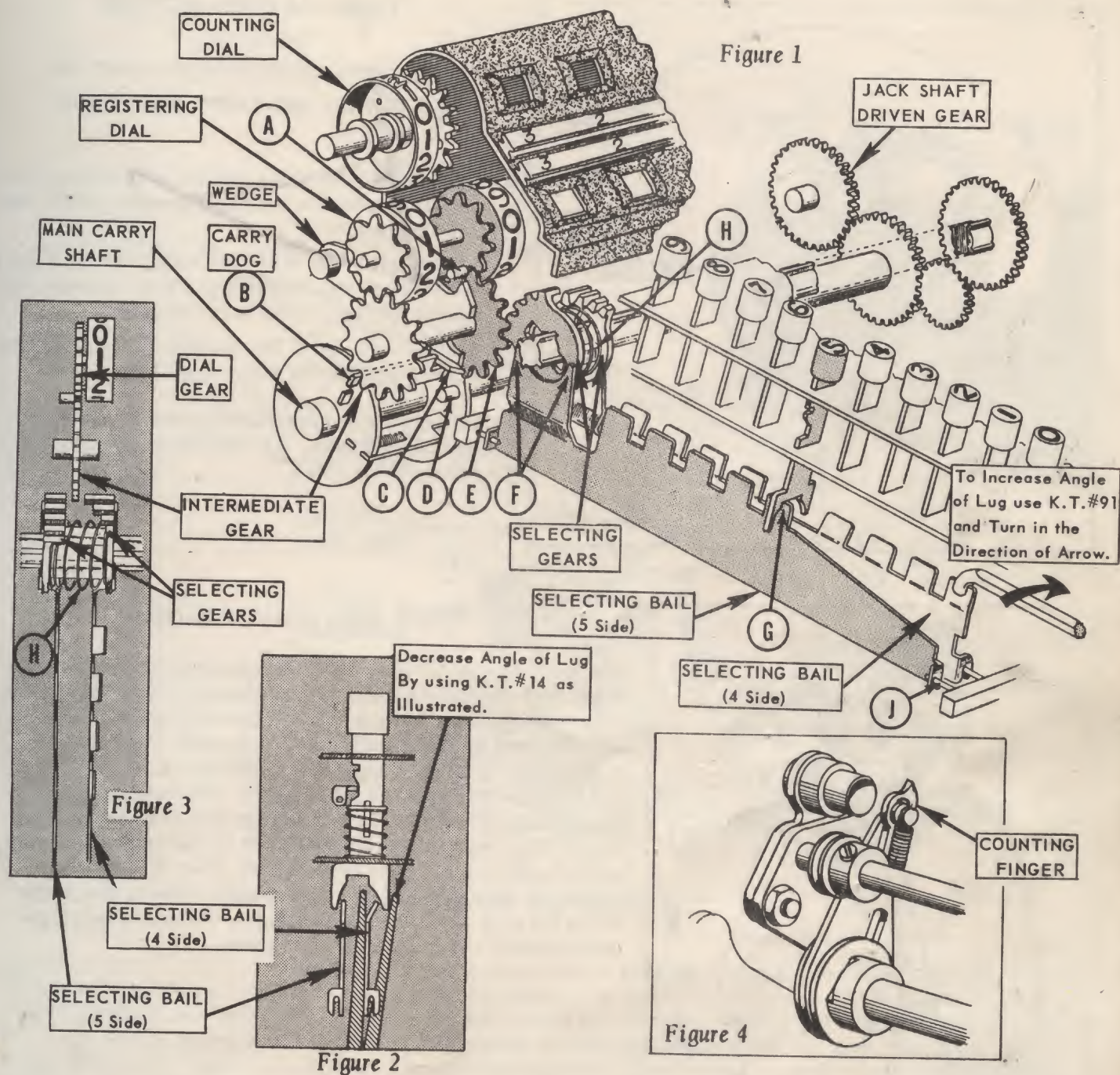
When the "9" capacity of a registering dial is exceeded by "1" through the medium of selector, intermediate and dial gears, a stud (A) on the gear of the registering dial engages a wedge in the same column and causes it to become depressed. After the wedge is depressed, the turning of the carry shaft causes a carry dog to cam sidewise due to engagement with the foot (C) of the wedge, thereby moving the upper lug (B) of the carry dog into mesh with the next higher order intermediate gear (to the left of the active columns) displacing the gear one tooth, which will result in a registering dial reading of "10". Immediately following this carry-over, a stud (D) on the carry shaft restores the wedge to its upward neutral position.

While the registering dials are thus being operated, the counting dials are revolved through the use of a counting finger which operates in an eccentric stroke from the carry shaft. See Figure 4.

Figure 5

TENS CARRY ACTION

SEQUENCE OF EVENTS RELATIVE TO SELECTION AND CARRY DOG ACTION

A. Approximately 90° of the addition calculating cycle is utilized to move the subtract dogs away from the intermediate gear.

B. Approximately 180° of the calculating cycle is utilized to provide an inactive dog zone during movement of the intermediate gear by the selecting gears.

C. Approximately 90° of the calculating cycle is utilized to permit the add dog action if required.

This illustration and explanation covers the clockwise, addition dog movement. The subtract dog movement is the reverse of the above.
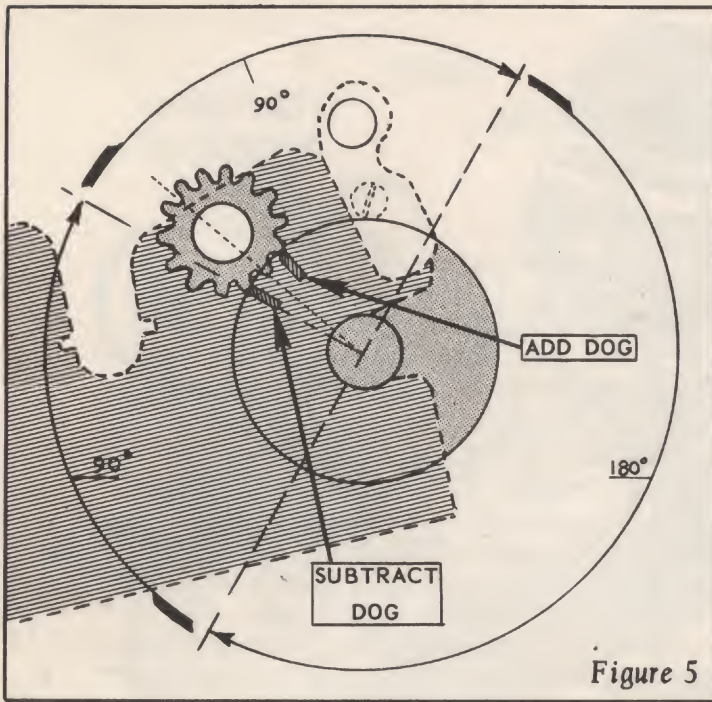

Figure 6

VIEWED FROM REAR OF MACHINE

The subtraction of "1" from "10" is accomplished by depressing the minus key. When this is done, a stud (A) on the registering dial engages a wedge in the same column and causes it to become depressed and held there by spring action. After the wedge is depressed, the turning of the carry shaft in the minus direction causes the subtract dog to cam sidewise (as did the add dog). This camming is due to engagement with the foot (C) of the wedge thereby moving the upper lug (B) of the subtract dog into mesh with the next higher order intermediate gear displacing the gear one tooth which will result in a registering dial reading of "9". Immediately following this, a stud (D) on the carry shaft restores the wedge to its upward neutral position where it is held by the wedge spring.
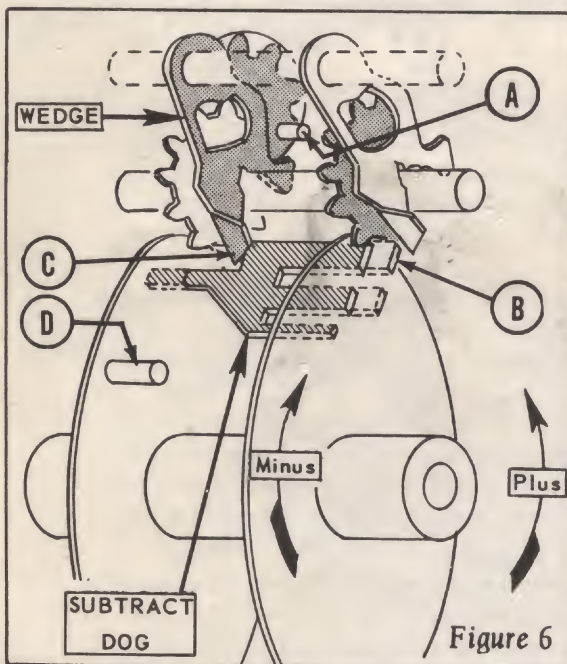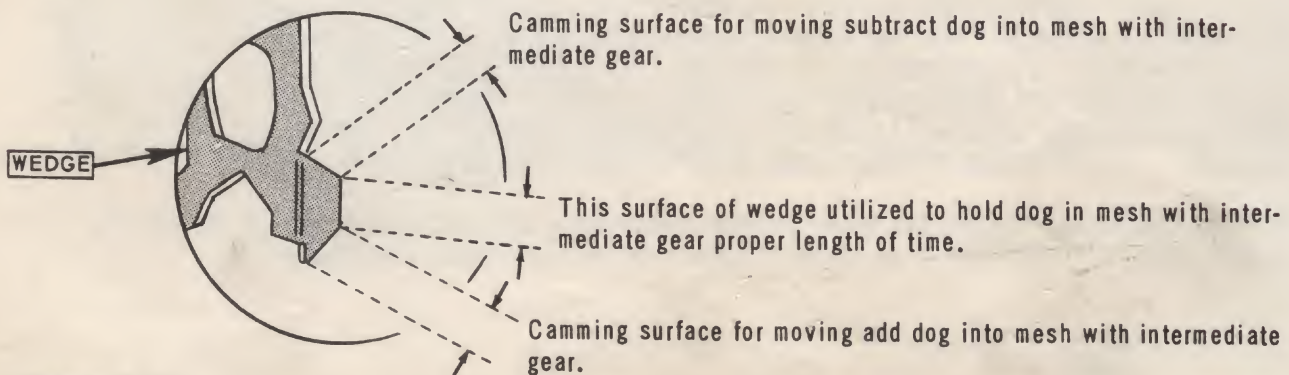

Camming surface for moving subtract dog into mesh with intermediate gear.

This surface of wedge utilized to hold dog in mesh with intermediate gear proper length of time.

Camming surface for moving add dog into mesh with intermediate gear.

Figure 7

Labels in figure: KEYBOARD LOCK LEVER, M, KEY LOCKING SHUTTER, KEYBOARD LOCKING BAR, DRIVING AND LOCKING CAM, SWIVEL ARM, HAND CRANK GEAR, N, KEYBOARD CLEARING BAR, P, NUMERAL KEYSTEM, K, ZERO KEYSTEM, L, CLEARING LEVER, NON-REPEAT KEY, ZERO KEY BAIL, R, Q, MASTER CLEAR KEY, ROCKER
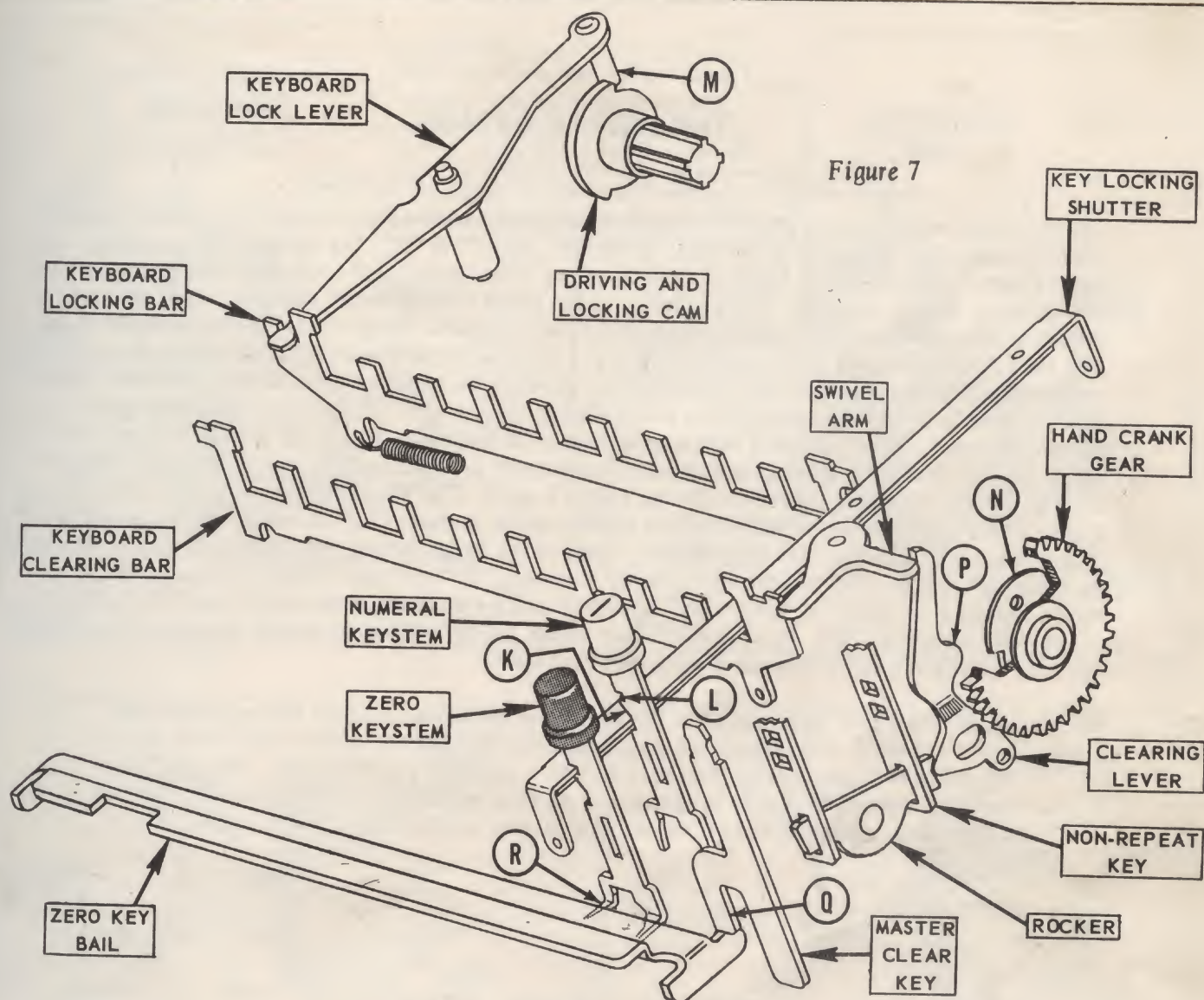
KEYBOARD CONTROLS

With the machine in neutral, the depression of a numeral keystem, (Figure 7), through the medium of a beveled surface (K), will cam the keyboard locking shutter in a pivoting movement away from the keystem until the depression limit is reached at which time a spring will pull the shutter into a notch (L) in the keystem, thereby locking the keystem downward. The pivoting movement of the shutter as the keystem was depressed caused the shutter to slide a locking bar to the left which in turn pivoted a lock lever. The movement of the lock lever caused its stud (M) to swing momentarily inward over a carriage locking driver cam. If, however, the machine had been partially cycled, the stud would have found the larger diameter of the driver cam blocking its path, thereby locking the keyboard against keystem depression until the cycling mechanism of the machine was neutralized. A spring restores the locking bar to neutral as the shutter enters the locking notch in the keystem.

Clearing the keyboard automatically with each cycle of machine operation is achieved by having the non-repeat key depressed. This forces a rocker against the clearing lever, moving it into the path of a cam (N) on the hand crank gear. As the gear revolves, its cam contacts the clearing lever at (P) causing it to pivot against a swivel arm which in turn pivots against the clearing bar. This slides the clearing bar to the left, and its lugs will move the shutters out of engagement with the depressed numeral keystems thereby permitting the keystem to restore upward to neutral.

Clearing the keyboard manually is achieved by depressing the master clear keystem. An extension arm (Q) on the keystem contacts the zero key bail pivoting its rearward edge downward to engage the off-sets (R) of the zero keystems. The downward movement of the zero keystems cam the shutters to the left and out of engagement with the depressed numeral keystems.
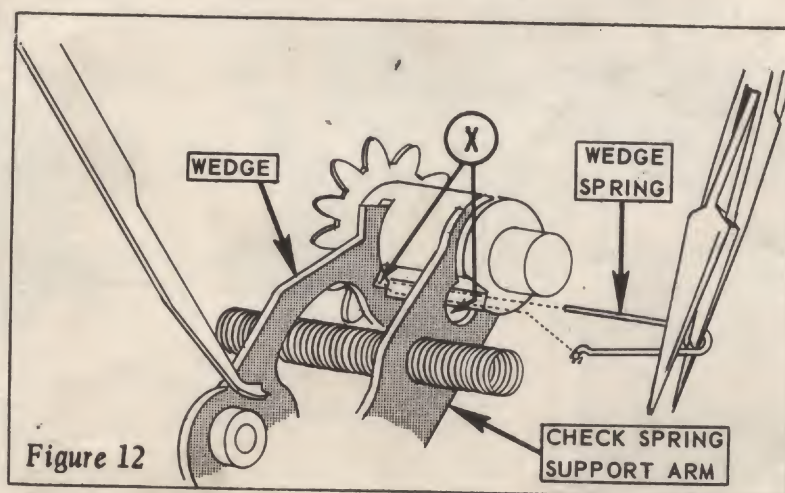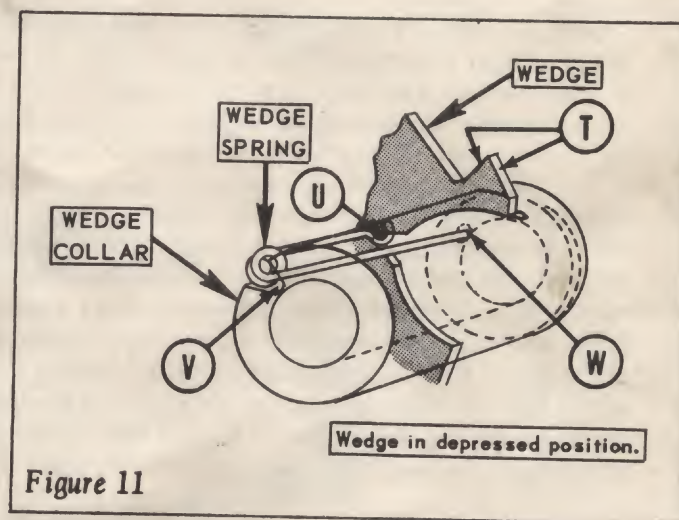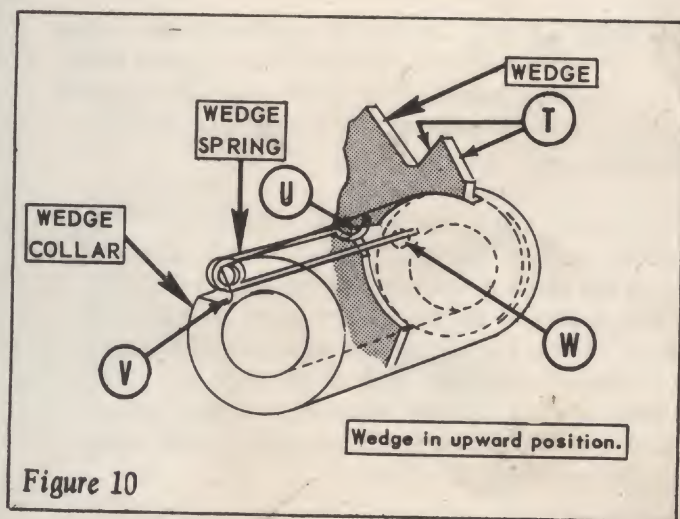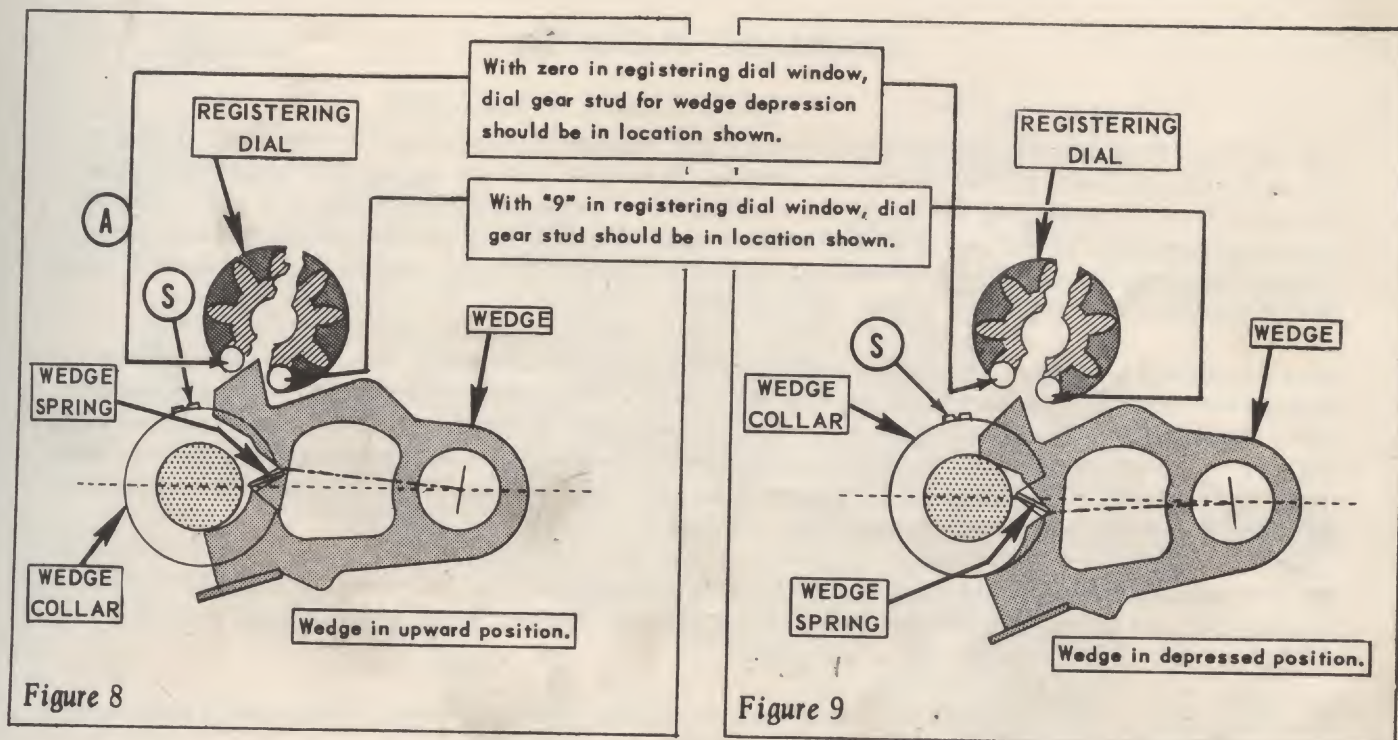
THE WEDGE ACTION

The tens-carry wedge is one of the most important parts of the machine and is used only in obtaining an additive or subtractive tens-carry (carry-over) "9" to "10", or "10" to "9". The wedge has two positions, upward, Figure 8, and downward, Figure 9. The lower rod of the wedge shaft assembly, serves as a limit stop for the wedge in both positions. The resistance of the wedge to movement in either upward of downward direction is provided by a small odd-shaped part known as a toggle or wedge spring. See Figures 10, 11 and 12. When the wedge spring is in position, one end is anchored in the groove (V) of the wedge spring collar and the other end in the notch (U) of the wedge and therefore the shifting of the center of resistance can be accomplished by turning the wedge spring collar slightly clockwise or counter-clockwise dependent on resistance required. To increase the downward resistance of the wedge, loosen the set screw (S) and turn the collar slightly clockwise, whereas to decrease the downward resistance of the wedge, loosen the set screw and turn the collar slightly counter-clockwise, Figure 8 and 9. The wedge is depressed when a stud (A) protruding from the registering carriage dial gear engages either surface (T) of the wedge. Two separate conditions may result from improper wedge action. First, if the wedge fails to move downward quickly enough, an "under-carry" may result and the dials instead of reading "10" will show "zeros"; second, if the wedge moves downward too easily an "over-carry" may result and the dials will erroneously read "19" instead of "9", or "20" instead of "10". Weak or mis-shapen wedge springs will cause trouble, therefore, inspect these springs carefully and use extreme care when installing them.

NOTE: Usage of the term "under-carry" in this bulletin is defined as improper loss of a tens-carry action or failure of the wedge and carry dog to displace the intermediate gear to the left of the wedge receiving a depression impulse from a registering dial stud (A). The term "over-carry" is intended to signify appearance of an uncalled-for "tens-carry", resulting from premature wedge and carry dog action, which displaced an intermediate gear in error.

WEDGE SPRING DETAIL

To insert a wedge spring, grasp the spring with a pair of thin jaw pliers or tweezers as shown in Figure 12, and using a thin "V" notched tool, very carefully thread the ends of spring through apertures (X) of check spring support arms and wedges. The end of the wedge spring will locate in a hole (W) in a bearing which supports the intermediate gear. The other end of the spring will grasp the seat of the notch (U) in the wedge. See Figures 10 and 11. Do not weaken the wedge spring by excessively collapsing it when installing. The wedge spring can be installed in several different ways using pliers or tweezers in connection with Kit Tool #35 or using the kit tool alone. This tool has a triangular aperture in one end through which the wedge spring is partially inserted and held by the walls of the aperture while the spring is inserted in the wedge shaft. Another means of inserting the wedge spring is to grasp the long straight end with pliers, insert the end in the large aperture of wedge and then back the coil of the spring into the aperture. With a spring hook or scriber, the coil can be pulled through the aperture of the wedge until the long end can be inserted in the aperture of the wedge, at which time the notched end of Kit Tool #35 should be used to also position the hooked end in the aperture.

With zero in registering dial window, dial gear stud for wedge depression should be in location shown.

With "9" in registering dial window, dial gear stud should be in location shown.

REGISTERING DIAL

A

S

WEDGE SPRING

WEDGE COLLAR

WEDGE

Wedge in upward position.

Figure 8

REGISTERING DIAL

S

WEDGE COLLAR

WEDGE SPRING

WEDGE

Wedge in depressed position.

Figure 9

WEDGE

T

WEDGE SPRING

U

WEDGE COLLAR

V

W

Wedge in upward position.

Figure 10

WEDGE

T

WEDGE SPRING

U

WEDGE COLLAR

V

W

Wedge in depressed position.

Figure 11

WEDGE

X

WEDGE SPRING

CHECK SPRING SUPPORT ARM

Figure 12

CARRIAGE CLEARING

The carriage is cleared by turning the carriage crank, Figure 14, one complete revolution clockwise and a complete revolution counter-clockwise. Viewing the machine from the right, a counter-clockwise revolution will clear the registering dials, whereas a clockwise revolution will clear the counting dials. The carriage registering dials (lower) and counting dials (upper) revolve on their shafts through intermediate gear and counting finger action and are held in their selected position by spring loaded plunger pins, the heads of which seat in recesses in the dial gears, Figure 14.

When the carriage clearout crank is being used for a registering dial clearout, (counter-clockwise), the carriage raises and the plunger pins cause the dials to revolve with the dial shafts until the dials, that may have been displaced from neutral by selecting gear action, are retarded by trip pawls. When the clearout trip pawls engage the clearout studs (Y) on the registering dial gears, the plunger pin spring pressure is overcome. These pawls are positioned in the path of clearout studs, (Y), which are so placed on the dials that when engaged by the trip pawls, the numeral "zero" appears in the carriage windows.

When the carriage clearout crank is being used for a counting dial clearout, (clockwise), studs (Z) of the counting dials are engaged by the trip pawls at which time the numerals "zero" of the counting dials appear in the carriage shell window.

The dial clearing shafts, Figure 14, are held in neutral position by locking fingers, which seat in notches (C1) and (D1) in hubs of intermittent gears on both dial shafts.

Turning the carriage clearout crank will cause the clearout shaft, Figure 13, to revolve and through the medium of two plunger pins and springs, an intermittent gear will be driven, dependent on the direction the hand crank is being turned. The depth to which the plunger pins are depressed in their clearout shafts holes is controlled by the variable diameter of the internal cam (A1). The engagement of the plunger pin, Figure 13-A, with the internal cam wall (B1) is the means by which the two intermittent gears are individually driven.

Operation of the clearout crank in a counter-clockwise direction will cause rotation of an associated shaft on which is fastened the carriage lift cam. The engagement of the carriage lift cam, Figure 15, with collars on the wedge shaft will raise the carriage sufficiently to release the gears of the carriage registering dial from mesh with wedge shaft gears in the base of the machine. The turning of the crank for clearing of registering dials also causes the innermost of two large intermittent gears to turn and engage the registering dial shaft drive gear. To unlock the shaft, the shaft locking finger is cammed downward from its locking notch (C1) in the shaft by means of a cam surface (E1) on the intermittent gear. Turning of the carriage clear crank clockwise results in the outer of the two intermittent gears, Figure 14, driving the counting dial shaft after camming the locking finger downward from its notch (D1) in the counting dial shaft.
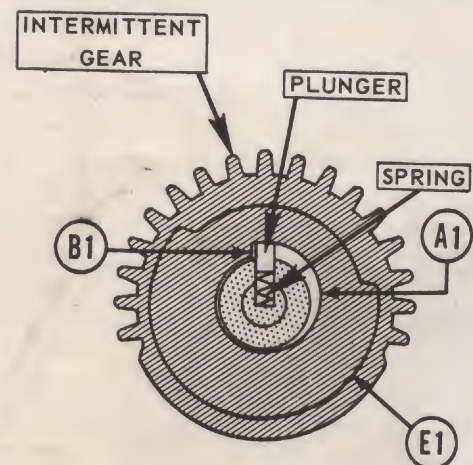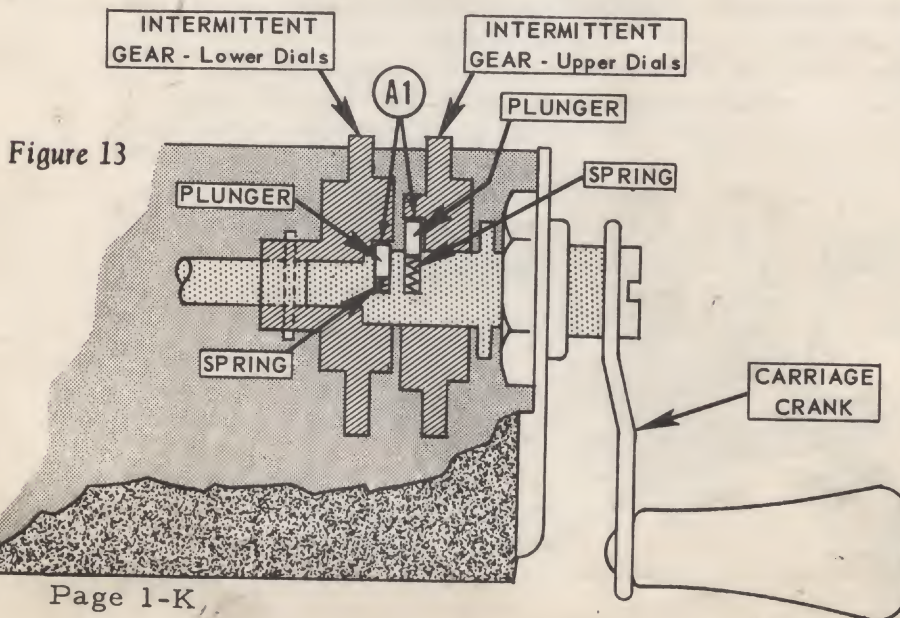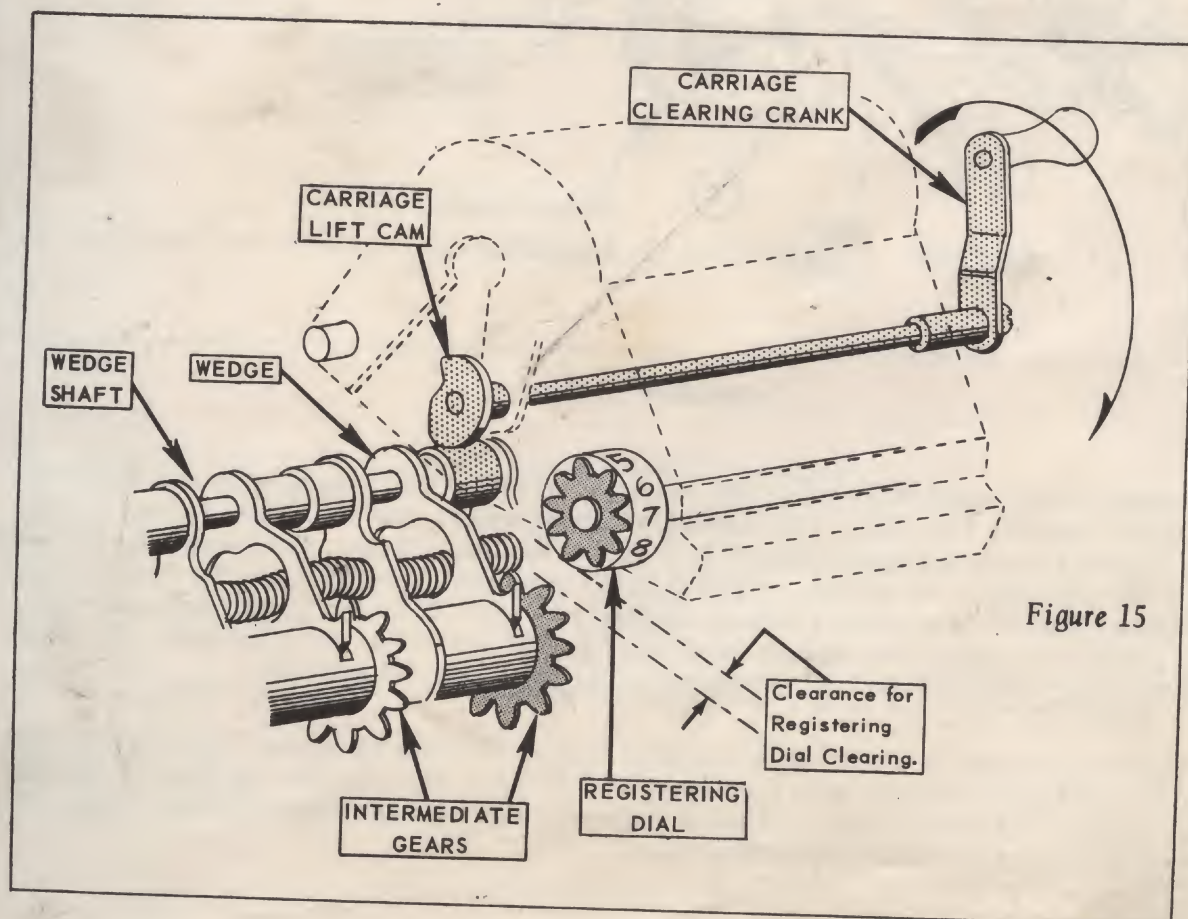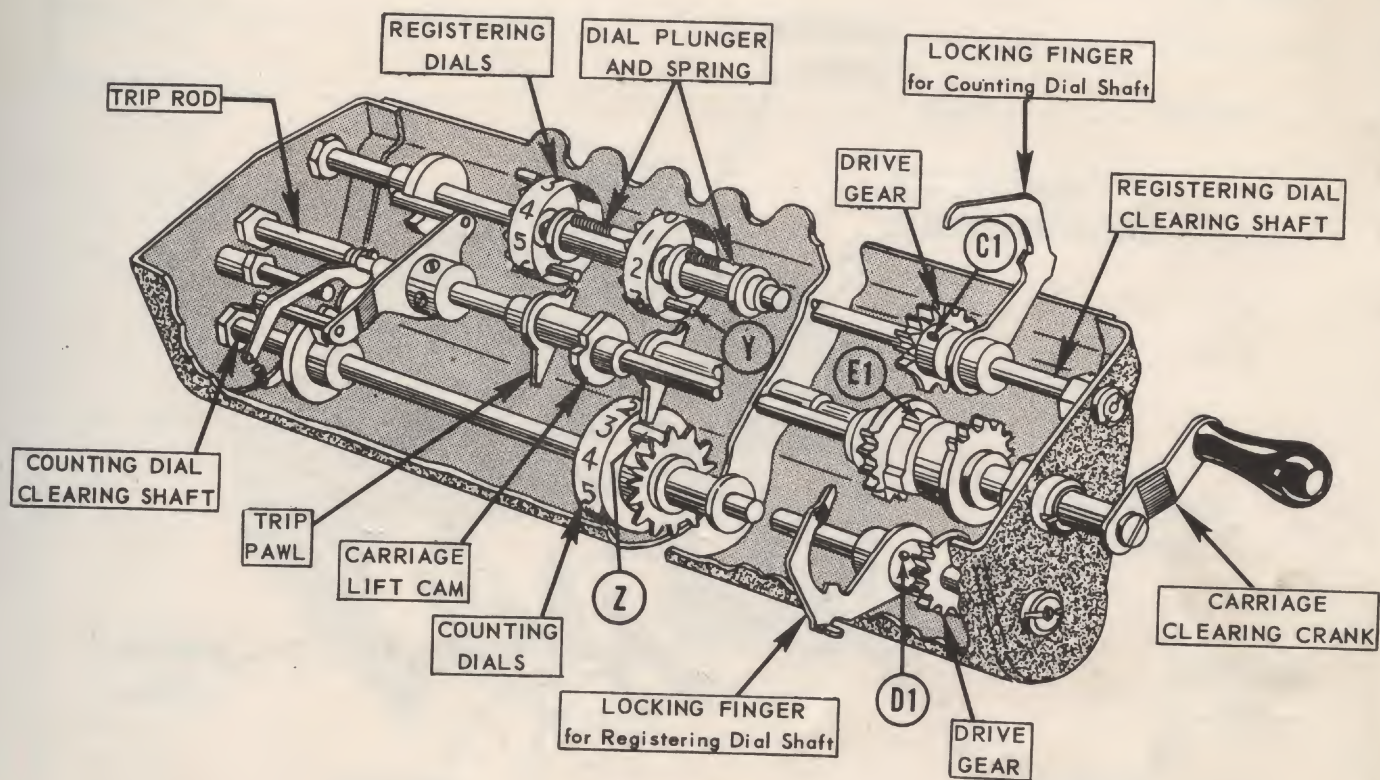

Figure 13

Figure 13-A

Figure 14

REGISTERING DIALS

DIAL PLUNGER AND SPRING

LOCKING FINGER for Counting Dial Shaft

TRIP ROD

DRIVE GEAR

REGISTERING DIAL CLEARING SHAFT

C1

E1

Y

COUNTING DIAL CLEARING SHAFT

TRIP PAWL

CARRIAGE LIFT CAM

Z

COUNTING DIALS

LOCKING FINGER for Registering Dial Shaft

D1

DRIVE GEAR

CARRIAGE CLEARING CRANK

CARRIAGE CLEARING CRANK

CARRIAGE LIFT CAM

WEDGE SHAFT

WEDGE

Clearance for Registering Dial Clearing.

Figure 15

INTERMEDIATE GEARS

REGISTERING DIAL

Figure 16

CARRIAGE SHELL

ECCENTRIC STUD

TRIP ROD LOCATING FINGERS

F1

G1

ROCKING CAM

COUNTING DIAL SHAFT

ROCKING CAM

COUNTING DIAL

H1

LOCATOR YOKE

A

REGISTERING DIAL SHAFT

Z

Y

TRIP ROD

TRIP PAWL

REGISTERING DIAL
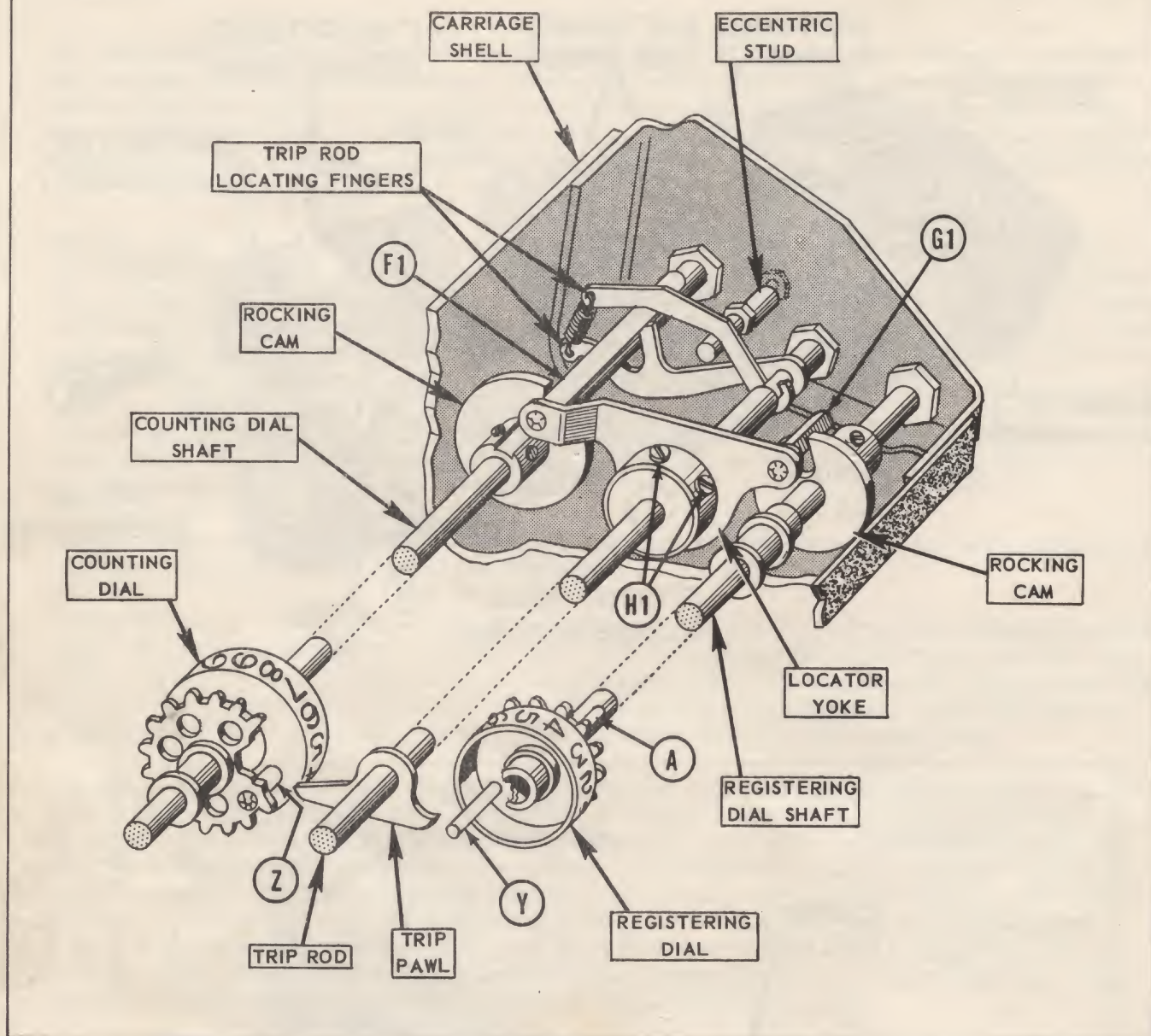
CARRIAGE CLEARING

The rotation of either dial shaft causes the clearing control trip rod, Figure 16, to rock toward the dials of the revolving dial shaft. This rocking movement results from the action of a rocking cam on the revolving dial shaft against stud (F1) or (G1) of the locator yoke. This causes the trip pawls to move into the path of the clearout studs (Y) on the registering dials or (Z) on the counting dials. The clearout stud (Y) is positioned between numerals "8" and "9" on registering dials, whereas clearing stud (Z) is positioned between black numerals "2" and "3" on counting dials. The registering dial wedge-engaging stud (A) is located between numerals "3" and "4".

The trip rod is restored to neutral by the locating fingers under spring tension. An eccentric stud in the L.H. end of the carriage shell provides a final means of adjusting the trip pawls to the dial clearout studs. The locator yoke is adjusted to the two dial cams by loosening its set screws (H1) and moving the yoke to the desired setting.

STUDENT _____ BRANCH _____ DATE _____

ORANGE EXAMINER _____ RIGHT _____ WRONG _____

1. Q. What carriage part actuates the wedge?

   A.

2. Q. What part is caused to move because of the wedge?

   A.

3. Q. What is an "overcarry"?

   A.

4. Q. What is the purpose of the wedge spring? How many are used in an LA-7-200 machine?

   A.

5. Q. Name the three ways in which the keyboard can be cleared?

   A.

6. Q. What is the purpose of the floating cam on the hand crank gear?

   A.

7. Q. If the machine is partially cycled, should you be able to depress digit keyboard keys?

   A.

8. Q. If a plunger pin binds downward in the carriage clearout shaft, what condition would result?

    A.

9. Q. How many engaging studs are found on each dial?

    A.

10. Q. What is the purpose of each?

    A.

11. Q. What is the purpose of the eccentric stud shown in figure 16?

    A.

12. Q. What is the purpose of the dial plunger and spring shown in figure 14?

    A.

13. Q. When is it necessary for the carriage to raise for a dial clearout operation?

    A.

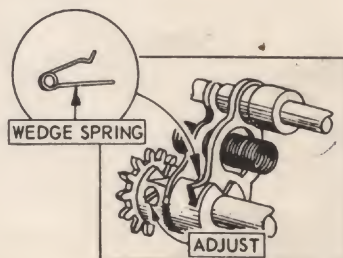14. Q. How is the carriage raised? Give two examples.

    A.

CARRIAGE SETTING

CYCLE CONTROL MECHANISM

THE CARRIAGE SETTING

Setting the carriage to the base of the Calculator is very important inasmuch as the dial reading may be in-correct if the gears of the registering dials do not properly align with the intermediate gears of the wedge shaft. Because the registering dials are driven by the intermediate gears of the wedge shaft, the gear teeth of both gears should have full alignment as shown in Figure 18. Incorrect depth of mesh between the teeth of these same gears will contribute to incorrect dial reading and carriage setting. It is, there-fore, important to see that the dials fully align as shown in Figure 18, and that there is maximum depth of mesh between them without a bottoming of the gears. See Figure 19. Proper carriage setting can be accomplished as follows:

1 Through the medium of its screws, (J1), adjust the carriage shifter rod strap, Figure 17, sidewise to suit. This will cause the shifter rod yoke (L1) positioned in the lock ledge, (K1) to slightly move the carriage assembly either to the right or left as desired. It is this adjustment that pro-vides the alignment of the gears. Up or down adjustment is accomplished by shimming the strap to avoid bottoming of the scallops on the rollers of the shifter rod yoke, (L1).

2 The depth of mesh is controlled by the setting of two carriage support arms through the medium of screws (M1). If these supports are adjusted properly, upward or downward, the carriage assem-bly, which pivots on the carriage hinge rod, will rest on these supports and thus prevent the bot-toming referred to above. After the supports have been correctly set, the hinge rod brackets should be adjusted forward and rearward so that the teeth of the registering dials can slide between the teeth of the wedge shaft gears without interfering with them. See Figure 19.

3 After these adjustments have been set and the support arm screws tightened, the carriage locks should be placed in position over the scalloped carriage lock ledge (K1) to hold the carriage down in correct mesh. If clearance exists between the adjustable tip (N1) of the locks and the top of the carriage lock ledge, it may be necessary to readjust the tips; after which their retain-ing screws (Q9) should be retightened. If the carriage locks cause a knock against the carriage lock cams when in position, it may be necessary to slightly readjust these tips upward. If the adjustment cannot properly be made with the tips, it may be necessary to resort to re-adjustment of eccentric studs, (P1) which are provided for both carriage locks.

4 In addition to proper mesh of intermediate gears of wedge shaft with registering dial gears, it is very important to have wedge springs of proper coil tension. Weak or excessively strong springs may cause trouble, as would improperly adjusted wedge collars. These adjustable wedge shaft collars provide a means of controlling the depression of individual wedges. When a faster depres-sion of a wedge is required, move the collar counter-clockwise. See Figure 9. If a delayed de-pression is called for, turn the collar slightly clockwise. After the desired adjustment has been made, tighten the set screw (S) securely.
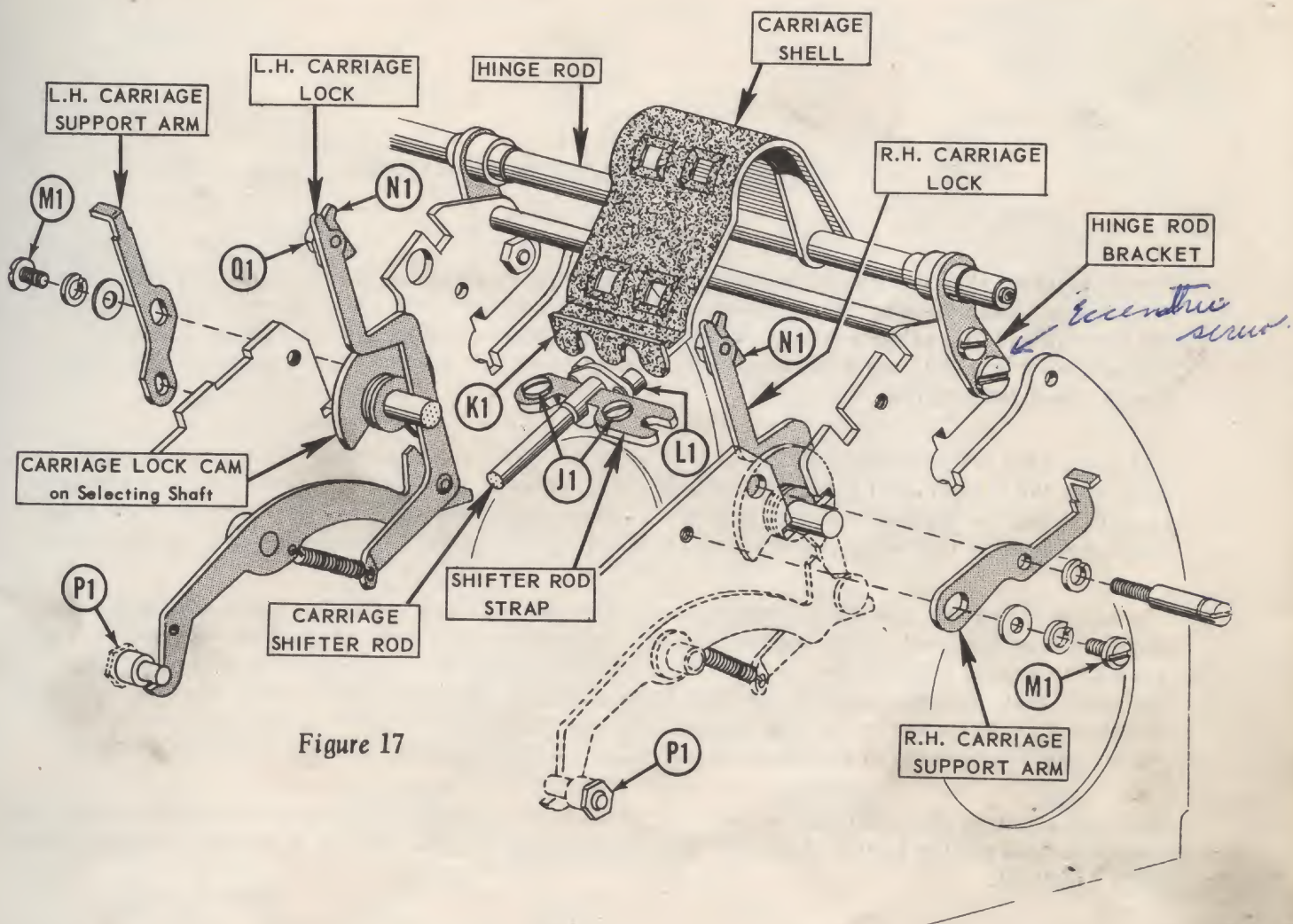

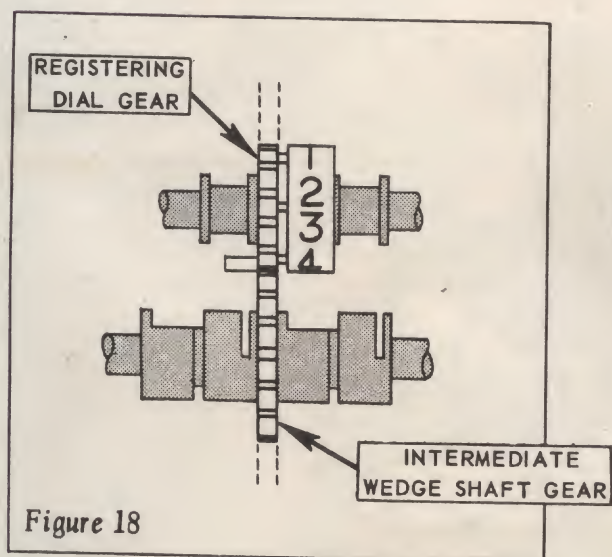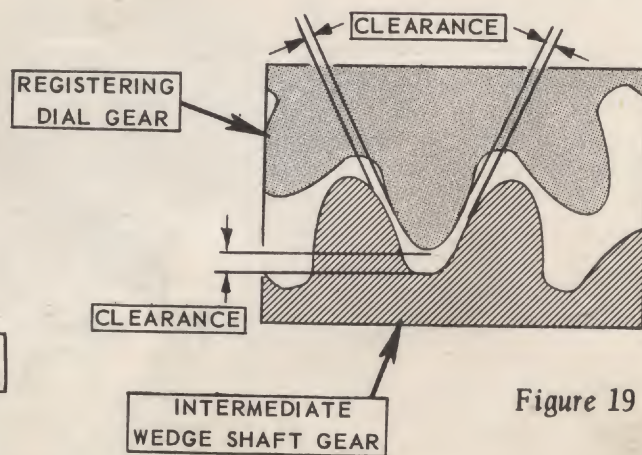WEDGE SPRING
ADJUST

Figure 17

Labels in Figure 17:
- L.H. CARRIAGE SUPPORT ARM
- L.H. CARRIAGE LOCK
- HINGE ROD
- CARRIAGE SHELL
- R.H. CARRIAGE LOCK
- HINGE ROD BRACKET
- M1
- N1
- Q1
- K1
- J1
- L1
- N1
- CARRIAGE LOCK CAM on Selecting Shaft
- P1
- SHIFTER ROD STRAP
- CARRIAGE SHIFTER ROD
- P1
- M1
- R.H. CARRIAGE SUPPORT ARM
- Eccentric screw (handwritten)

Figure 18

Labels in Figure 18:
- REGISTERING DIAL GEAR
- INTERMEDIATE WEDGE SHAFT GEAR

Figure 19

Labels in Figure 19:
- CLEARANCE
- REGISTERING DIAL GEAR
- CLEARANCE
- INTERMEDIATE WEDGE SHAFT GEAR

CYCLE CONTROL MECHANISM

Proper adjustment of the tripping mechanism is essential in obtaining the correct timing of the tripping action. When the mechanism is neutralized, a 1/32" hold of the cycle stop arm latch (R1) to the flexible end (S1) of the trip lever should exist, as shown in Figure 20. To obtain this hold, loosen screw stud (T1) and adjust the guide bracket upward or downward until proper setting is attained. Re-tighten screw.

The cycle stop bracket should be set so that its offset limits the movement of the cycle stop arm away from the bumper until a 1/32" clearance exists between the rearward end of the cycle stop arm latch (R1) and the rocking lever. Figure 20. To make this adjustment, loosen screw (U1) and move stop bracket away from or toward the bumper until desired clearance is obtained. Re-tighten screw.

The points (V1) of the dial-stud-engaging-surfaces of the trip lever are set to the alignment of, or slightly below the crest, of the uppermost tooth of the extra carry gear. Figure 20 and Inset 1. The extra carry gear is provided for the purpose of carrying beyond the capacity of the 10th position of the carry shaft. An adjustment is provided for upward and downward setting of the trip lever engaging surfaces (V1) in relation to the dial studs (A) by loosening the screw (W1) on the trip lever and moving the trip lever upward or downward to suit, after which the screw should be tightened securely.

When the dial stud (A) is located on the point (V1) of the trip lever, there should be approximately 1/32" clearance between the bottom of the trip lever flexible end (S1) and the top of the cycle stop arm latch (R1). Figure 21.
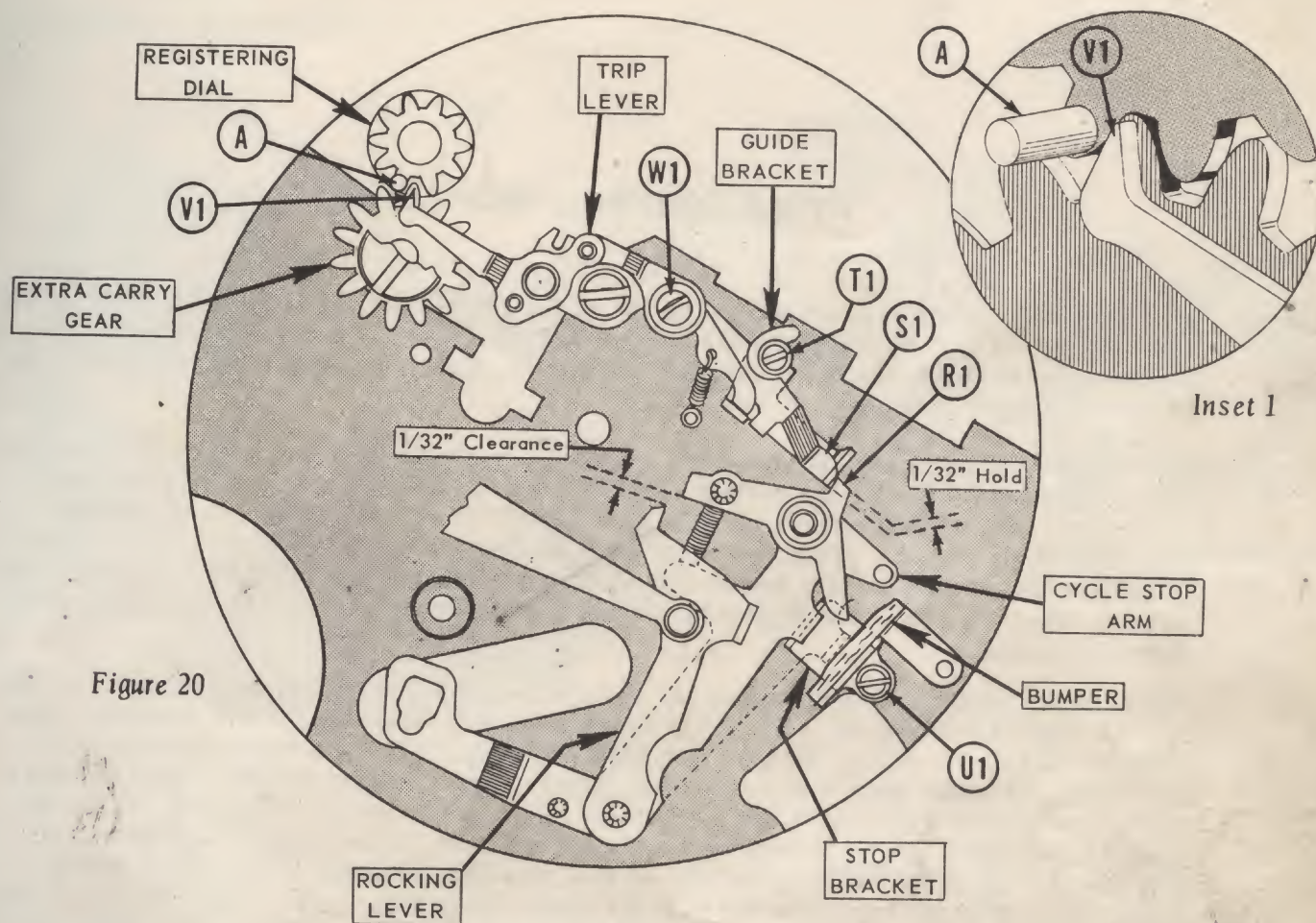

BUMPER & BRACKET

STOP BRACKET

Figure 20

REGISTERING DIAL

A

V1

EXTRA CARRY GEAR

TRIP LEVER

W1

GUIDE BRACKET

T1

S1

R1

1/32" Clearance

1/32" Hold

CYCLE STOP ARM

BUMPER

U1

STOP BRACKET

ROCKING LEVER

A

V1

Inset 1

Figure 21

REGISTERING DIAL

A

V1

EXTRA CARRY GEAR

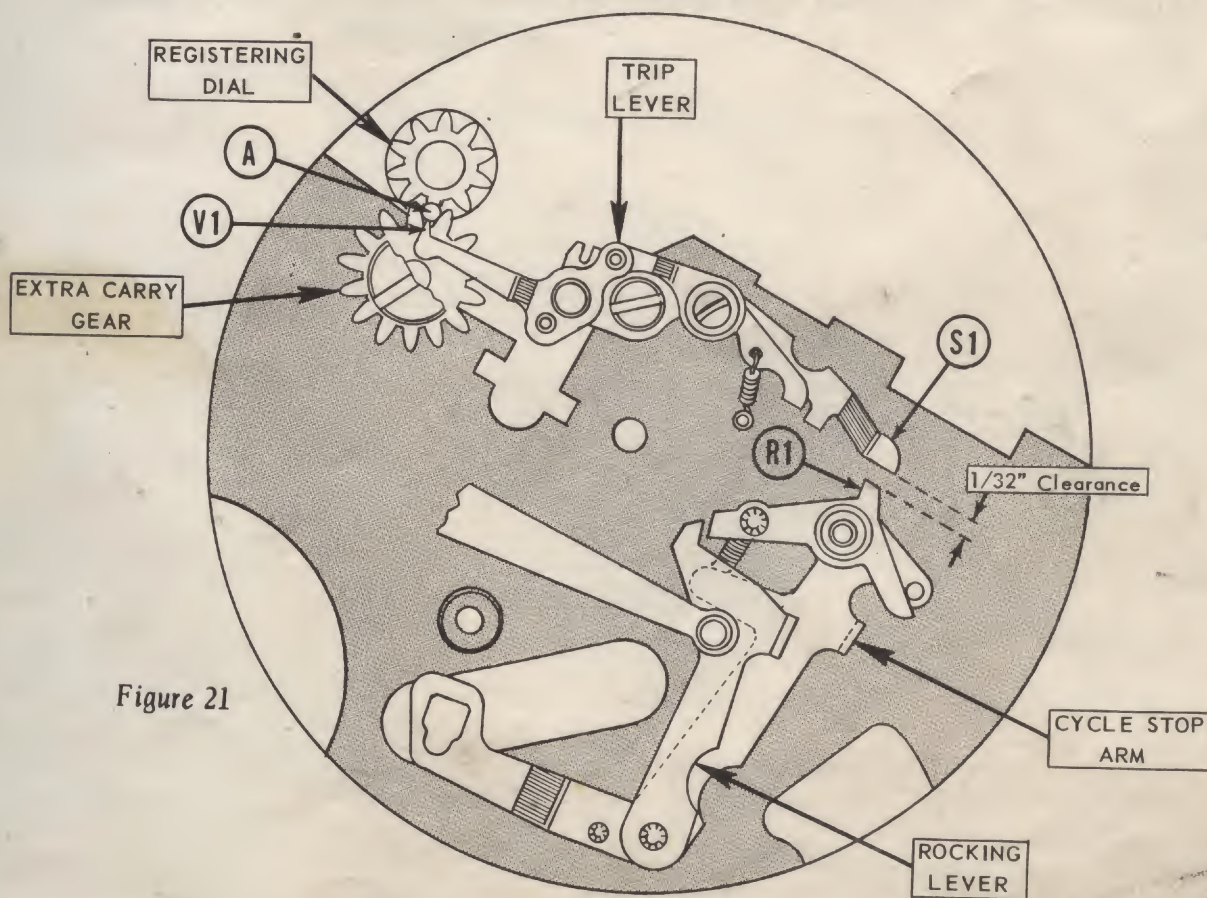TRIP LEVER

S1

R1

1/32" Clearance

CYCLE STOP ARM

ROCKING LEVER
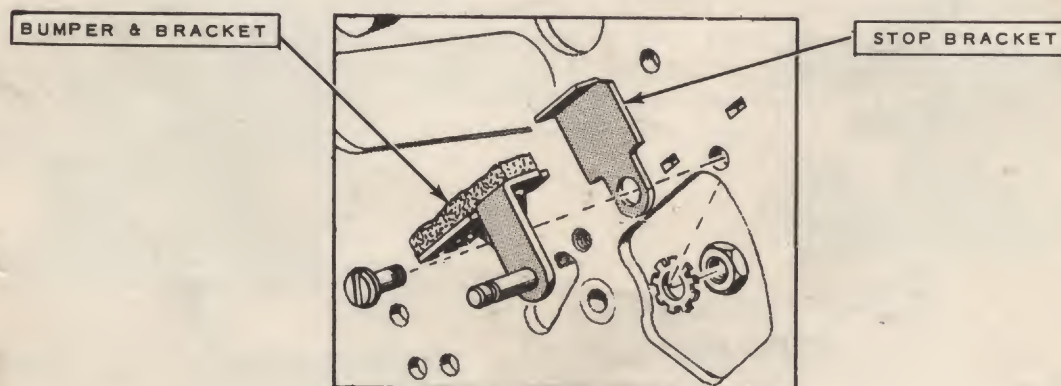
CYCLE CONTROL MECHANISM

When the plus or minus keys are depressed, the offset (X1) of the quick stroke latch should locate under the step (Y1) of the machine stopping lever slightly before the lifting blank (Z1) trips and locates under the trip lever flexible end (S1). Figure 22. This adjustment is made by bending the offset (X1) upward or downward to suit.

With the quick stroke latch positioned as shown in Figure 23 and the lifting blank (Z1) of the machine stopping lever holding the flexible end (S1) of the trip lever at its highest position, there should be 1/32" clearance between the bottom of the flexible end (S1) and the top of the latch (R1) of the cycle stop arm. When the lifting blank (Z1) trips off the flexible end (S1) of the trip lever, there should be clearance between the stop stud (A2) and the sub latch (B2) of the machine stopping lever. To obtain this adjustment, loosen screw (C2) and set the stop bracket upward or downward to suit.

Adjust the clutch yoke position holding arm by means of its eccentric adjusting hexagon (D2), so that the roller (E2) of the arm is located in the plus notch of the clutch yoke as shown in Figure 24 while the plus arm (F2) of the yoke is engaged with a lug (G2) of the internal gear by a 3/4 hold. When the clutch yoke is in this position (plus), its neutralizing stud (H2), which protrudes through the aperture of the cycle stop arm, should be located as shown in Figure 25. If the neutralizing stud limits against the wall of the aperture and does not permit a 3/4 hold of the yoke plus arm on a lug of the transmission internal gear, re-adjust the clutch yoke position holding arm slightly. When the cycle stop arm is at the bumper (Figure 25 - broken lines), the neutralizing stud is located in the lower portion of the aperture and does not contact the aperture walls.
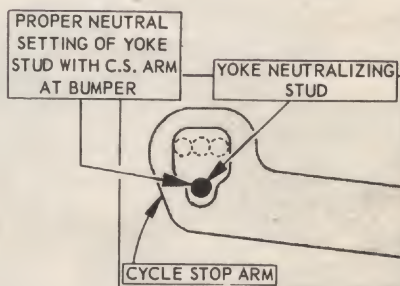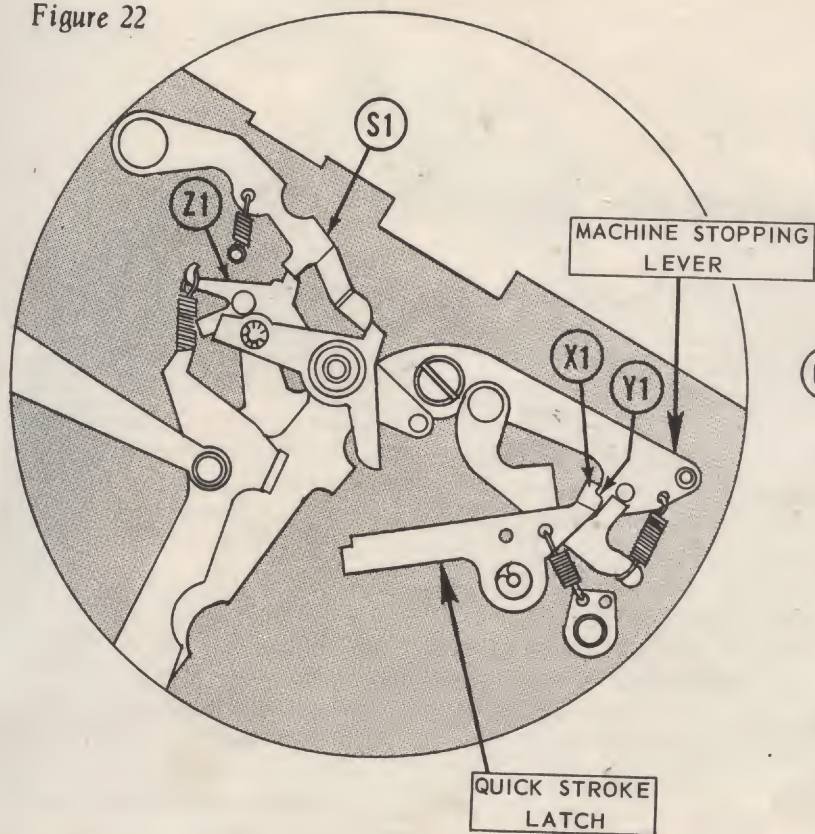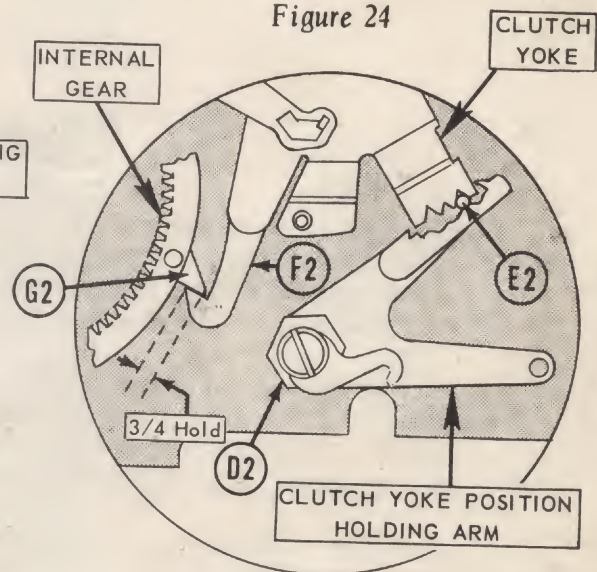

PROPER NEUTRAL SETTING OF YOKE STUD WITH C.S. ARM AT BUMPER

YOKE NEUTRALIZING STUD

CYCLE STOP ARM

Figure 22

- S1
- Z1
- MACHINE STOPPING LEVER
- X1
- Y1
- QUICK STROKE LATCH

Figure 24

- INTERNAL GEAR
- CLUTCH YOKE
- G2
- F2
- E2
- 3/4 Hold
- D2
- CLUTCH YOKE POSITION HOLDING ARM

Figure 23

- STOP BRACKET
- C2
- S1
- MACHINE STOPPING LEVER
- Z1
- 1/32" Clearance
- R1
- A2
- Clearance
- B2
- CYCLE STOP ARM
- QUICK STROKE LATCH

Figure 25

- Bumper Position
- H2
- Plus Position
- CYCLE STOP ARM
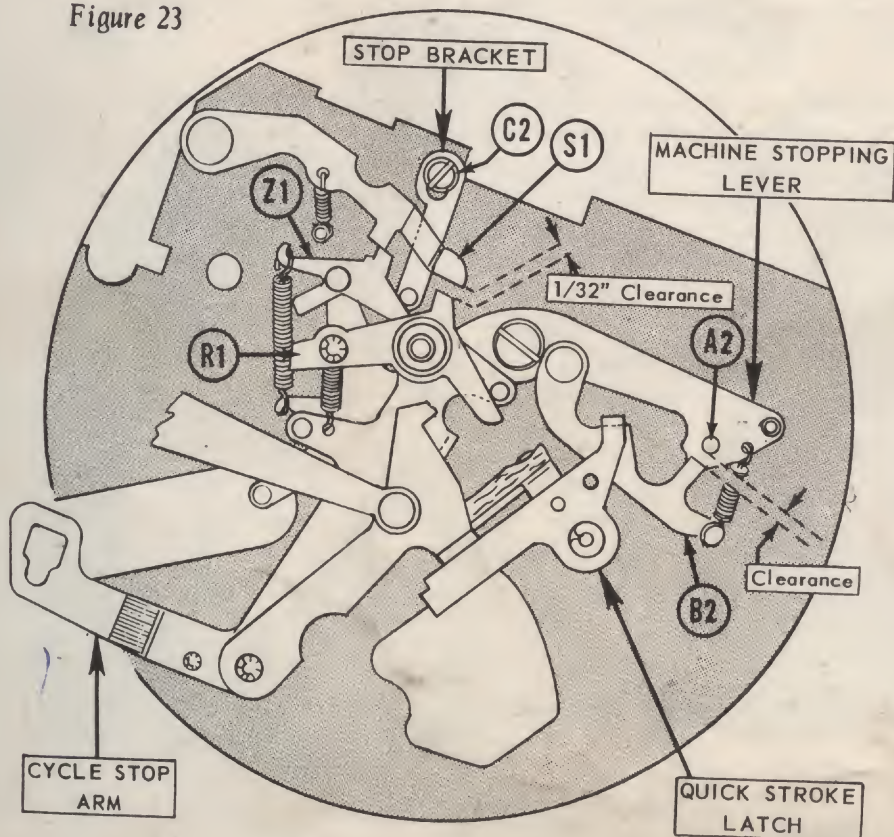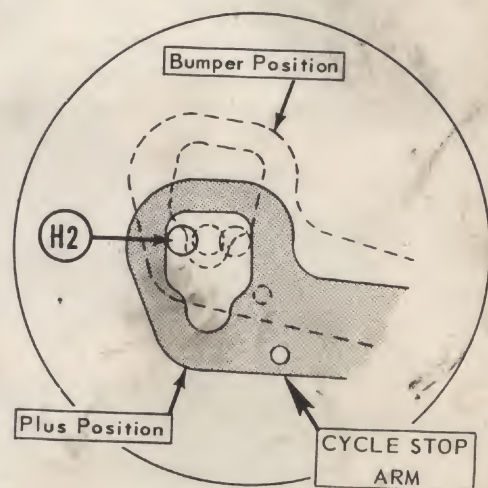
CYCLE CONTROL MECHANISM

Operation of the plus or minus key causes the clutch yoke to be operated due to the clutch yoke positioner engaging the operating arm on the clutch yoke. This movement would also cause the roller (J2) on the machine stopping lever to move downward and 'load' the lever for a trip when pressure is removed from the plus or minus key.   Figure 26.

The clutch yoke operating arm is adjusted by loosening its retaining screw (K2) and moving the arm to the desired upward or downward position for proper movement of the clutch yoke into plus or minus position.   The plus movement can be controlled by loosening the two screws (L2) on the yoke positioner and moving the stop bracket (W2) forward or rearward to suit. Figures 26 and 27.

Movement of the division lever into the operative position causes the trip engaging arm (M2) to move rearward and contact the extension arm (N2) of the clutch yoke, moving the clutch yoke into the minus position.   The remaining rearward movement of the trip engaging arm should be enough to allow the extension arm to become latched into operative position by the trip latch (P2). To obtain proper adjustment, turn eccentric screw stud (Q2) right or left. See Figure 28.

During automatic division operation, the carry shaft crank stud (R2) should engage either side of the extension arm blank (S2) with sufficient hold to throw the clutch yoke into plus or minus positions from neutral. This adjustment is made with the clutch yoke in minus position and the extension arm (N2) latched in operative position by the trip latch (P2). Loosen screws (T2) and set blank (S2) against the flat of stud (R2) so that a slight rub occurs when carry shaft crank is moved.   Figure 28. Then move clutch yoke into plus position and see that blank (S2) is positioned close to, but not contacting stud (R2) when crank moves.   Inset 2.

When the division lever is restored to neutral, the clutch yoke will receive a final movement into minus followed by a correction or plus stroke. On this plus movement of the yoke, the stud (U2) on the division lever is contacted by the yoke trip latch (P2) as shown in Figure 29 and Inset 3. This will cause an unlatching of the yoke extension arm (N2) as the roller (E2) of the yoke position holding arm starts to enter the plus notch of the clutch yoke. The stud (U2) on the division lever is held in position by the division lever position holding arm shown in Figure 29, and is adjusted by means of an eccentric hexagon (V2).
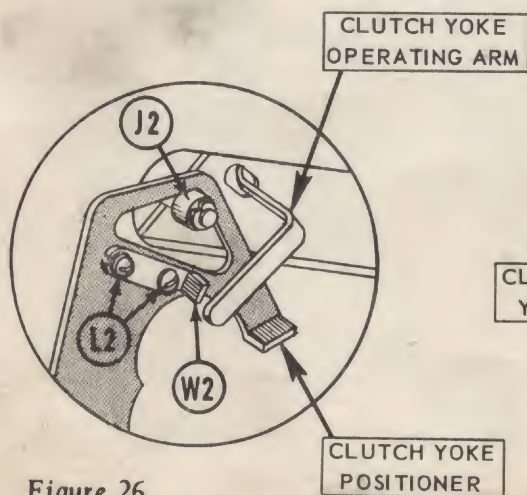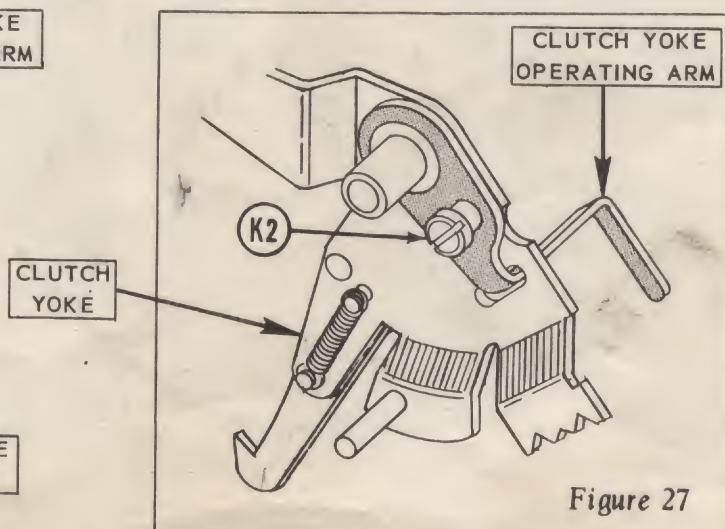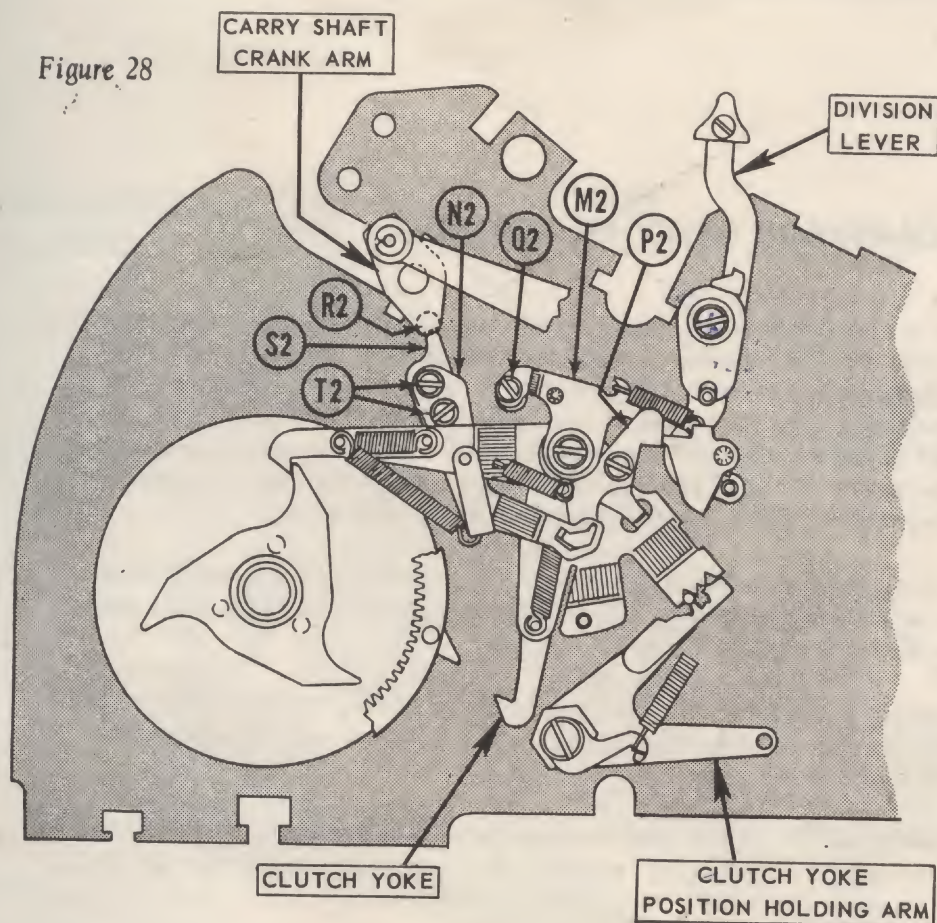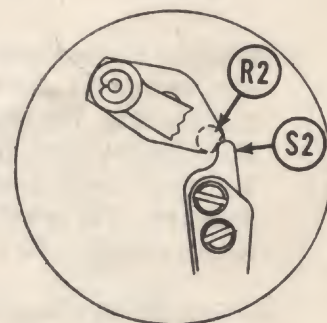

Figure 26

Figure 27

Figure 28

CARRY SHAFT
CRANK ARM

DIVISION
LEVER

N2 Q2 M2 P2

R2

S2

T2

Inset 2

R2

S2

CLUTCH YOKE

CLUTCH YOKE
POSITION HOLDING ARM

Inset 3

Figure 29

DIVISION
LEVER

P2

U2

N2

U2

P2

N2

E2

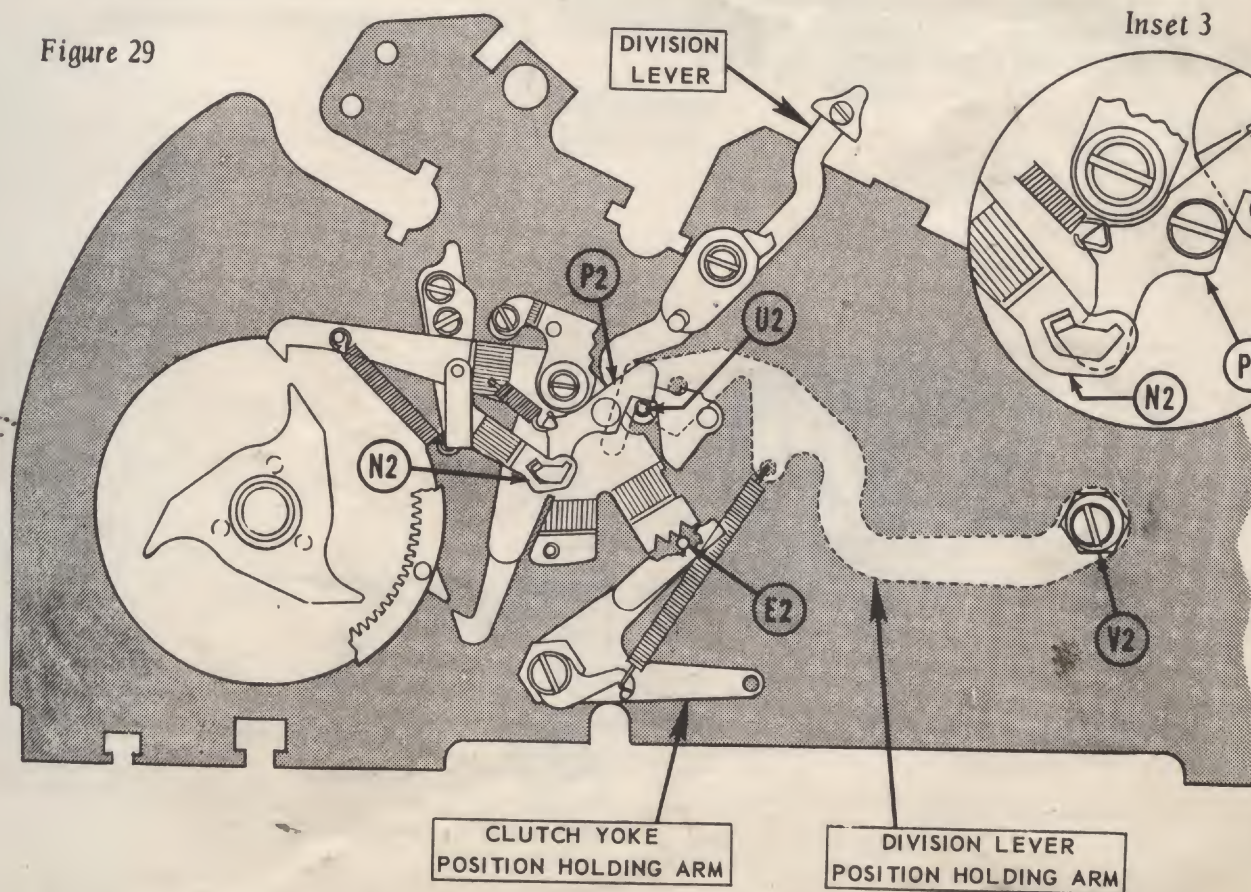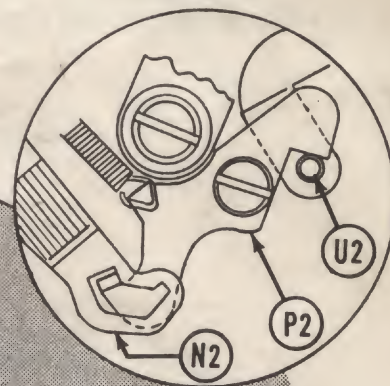V2

CLUTCH YOKE
POSITION HOLDING ARM

DIVISION LEVER
POSITION HOLDING ARM

CARRIAGE SHIFT MECHANISM

When the division lever is in operative position, the movement of the cycle stop arm to the bumper will, on a minus stroke, cause the shift coupling latch arm to position under the hook of the shift coupling arm. The shift driving lever will contact the roller on the shift coupling arm and drive the shift coupling latch arm downward. The shift coupling latch arm is attached to the automatic shift arm, which, in its downward movement, causes a pivoting of the shift cam lever and a raising of the shift cam. The upward movement of the shift cam will cause the ratchet on the cam to engage the ratchet pinned to the carriage shifter rod and cause the carriage to shift one place.

Adjust the lower lug (X2) of the shift coupling latch arm by bending where it rests on the division lever position holding arm so that the upper offset (Y2) fully seats under the hook (Z2) of the shift coupling arm following the first minus bumper stroke. Figure 30.

Excessive play between the top of the upper offset (Y2) of the shift coupling latch arm and the hook (Z2) of the shift coupling arm can be eliminated by turning the eccentric hexagon (A3) in the shift coupling latch arm. Figure 30.

Adjust roller (B3) by loosening nut (C3) on the shift coupling arm so that the bottom point (D3) of the engaging face of the shift driving lever strikes the roller approximately in the center when the cycle stop arm is at the bumper. Inset 4.

Adjust the eccentric roller (E3) on the shift cam lever so that it is at its lowest position toward the left. Then adjust its stop screw (F3) so that approximately 1/32" exists between the ratchets on the shifter rod. See Figure 30 and Inset 5.
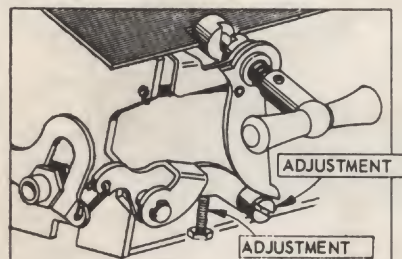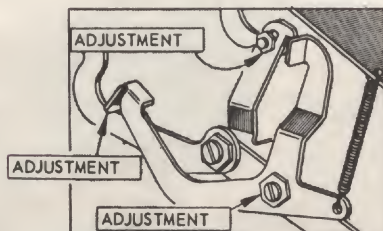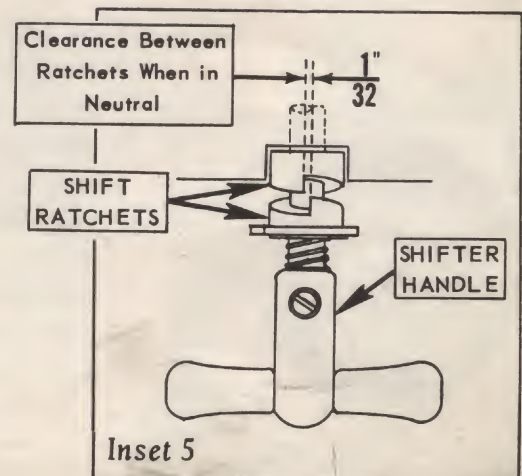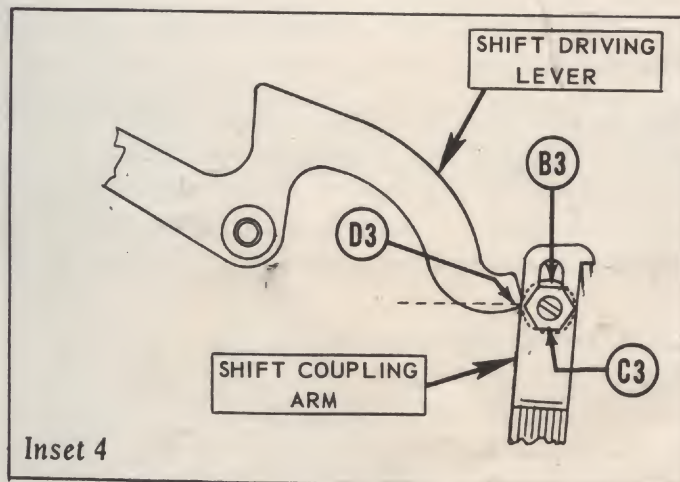
Figure 30

SHIFT DRIVING LEVER

DIVISION LEVER

AUTOMATIC SHIFT SLIDE

CARRIAGE SHIFTER ROD

SHIFT COUPLING ARM

Z2

Y2

X2

A3

SHIFT RATCHET

SHIFTER HANDLE

SHIFT CAM

DIVISION LEVER POSITION HOLDING ARM

SHIFT COUPLING LATCH ARM

AUTOMATIC SHIFT ARM

SHIFT CAM LEVER

F3

E3

SHIFT DRIVING LEVER

B3

D3

SHIFT COUPLING ARM

C3

Inset 4

Clearance Between Ratchets When in Neutral

$\frac{1}{32}$"

SHIFT RATCHETS

SHIFTER HANDLE
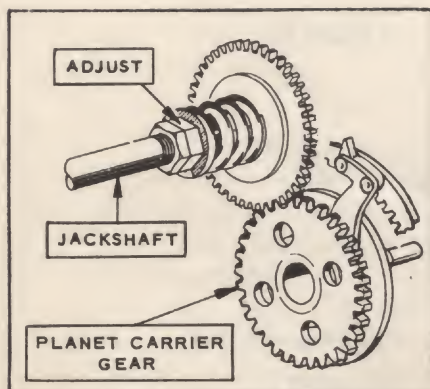
Inset 5
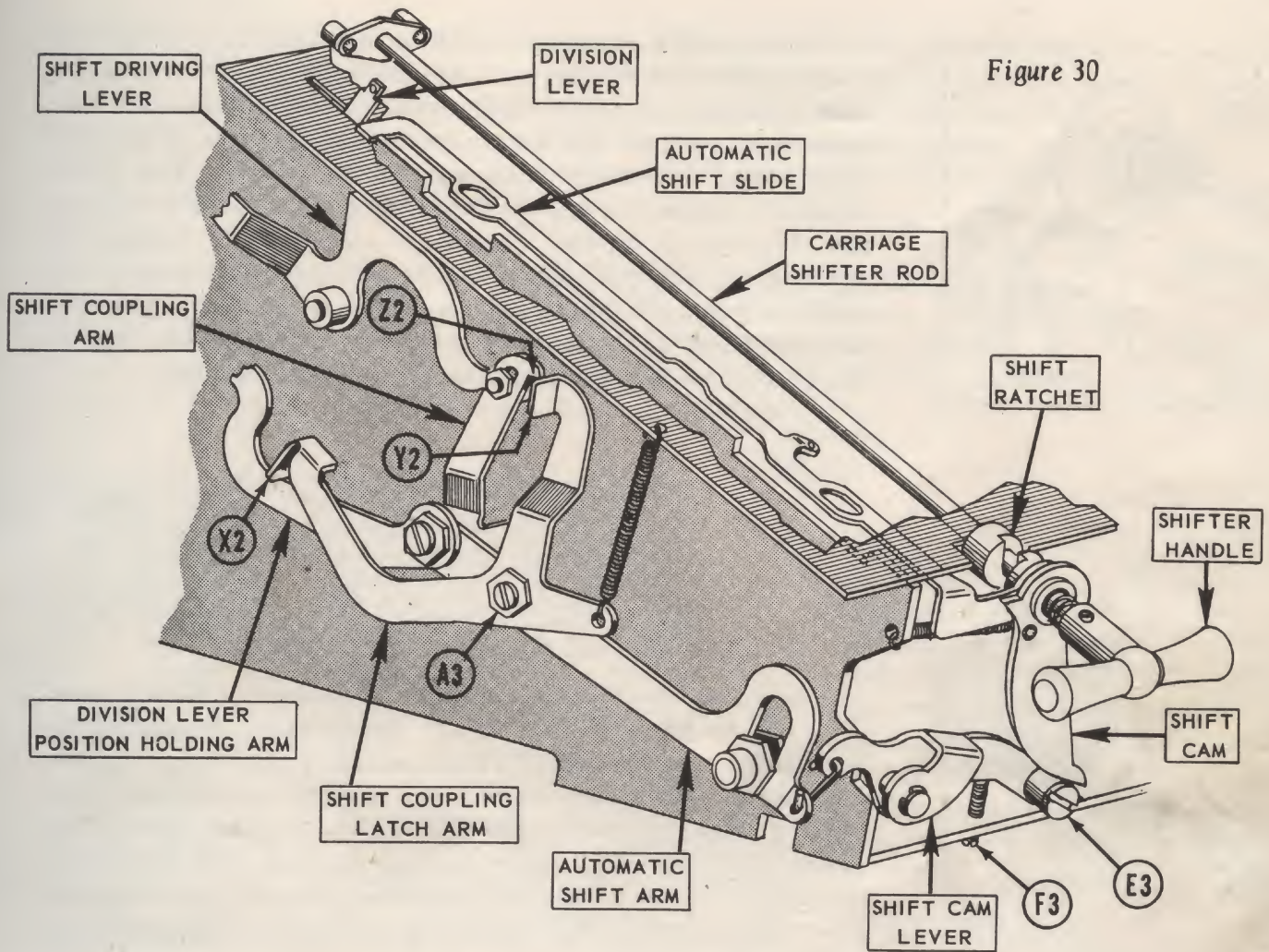
A friction slip clutch is used in automatic 'L' machines to provide a yieldable connection between the transmission and the rotatable shafts of the mechanism. Its purpose is to permit the motor armature to turn, if the machine should become locked for any reason. The clutch should be tight enough to drive the machine when all '9s' are depressed in the keyboard. To adjust, loosen the locking nut and turn the friction setting nut inward or outward to suit. If the carriage shifts sluggishly, increase the friction, if the shift movement is excessive, reduce the friction. Do not apply unnecessary friction.
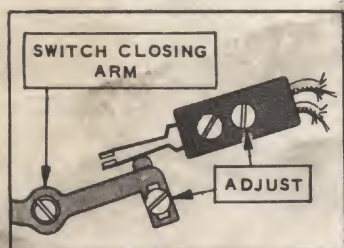
The movement of the clutch yoke causes the switch closing arm to rock and to close the contact points of the start and stop switch. The closing of the contact points permits a flow of current to the motor, causing its armature to start rotating and turning the transmission. The lower blade should exert enough pressure on the switch closing arm to raise the machine locator arm. Excessive tension may cause hard plus and minus keys depression.
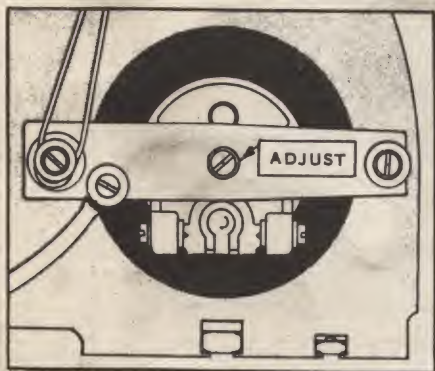
Proper machine performance is dependent on factory recommended speed. Adjust the speed of machine by inserting a screwdriver in the speed screw and turning it inward or outward to suit. A hole is provided in the R.H. cover case to permit entry of the screwdriver for speed adjustment.

LA, LA-5, LA-6 set at 380 R.P.M.
LA-7 set at 400 to 410 R.P.M.

CYCLE CONTROL MECHANISM

A division problem can be terminated by (1) Restoring the division lever manually to neutral (2) Automatic means at the completion of a division problem. The latter is accomplished by a stud (B) on the carriage engaging the upper tip of lever (A) when the carriage arrives at its "home" position.

A lowering of (A) drops the push lug on (D) into the path of the drive arm attached to the division lever. When the cycle stop arm moves toward the front of the machine, it pulls (D) with it, causing the division lever to be automatically restored to its neutral position.
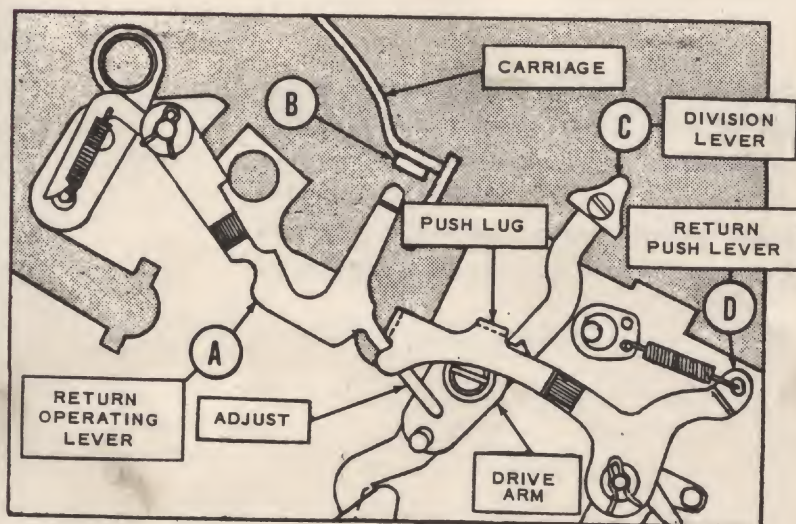
Adjust the division return mechanism by bending the control lug upward or downward so that the push lug on the push lever engages the offset on the drive arm with a full hold and returns the division lever to neutral when the carriage reaches the last position in division.

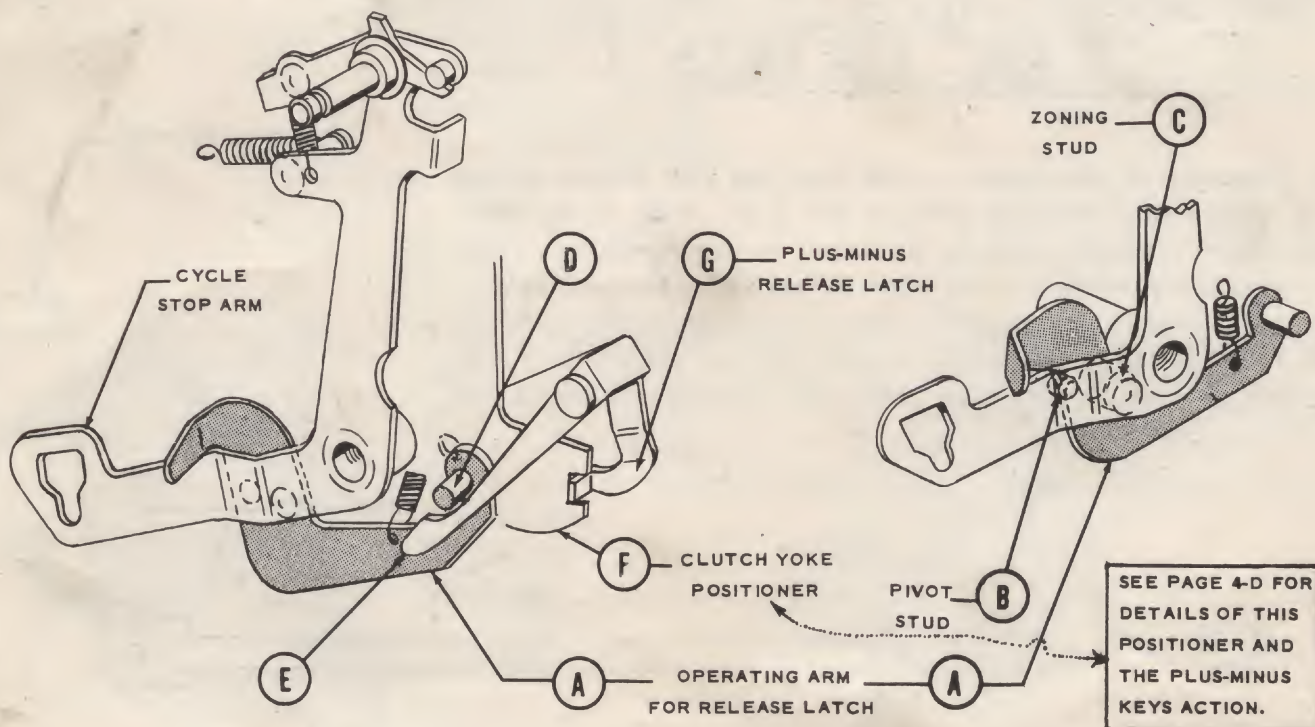The purpose of the hand crank cut-out rod shown below, is to lower the locating arm on the L.H side of the machine when a hand crank is inserted in the machine. This rod cams the switch closing arm upward and subsequently, the locator arm downward. This lowering of the locator arm is necessary in order to permit the rock lever and connecting link to operate their full movement when the hand crank is moved.
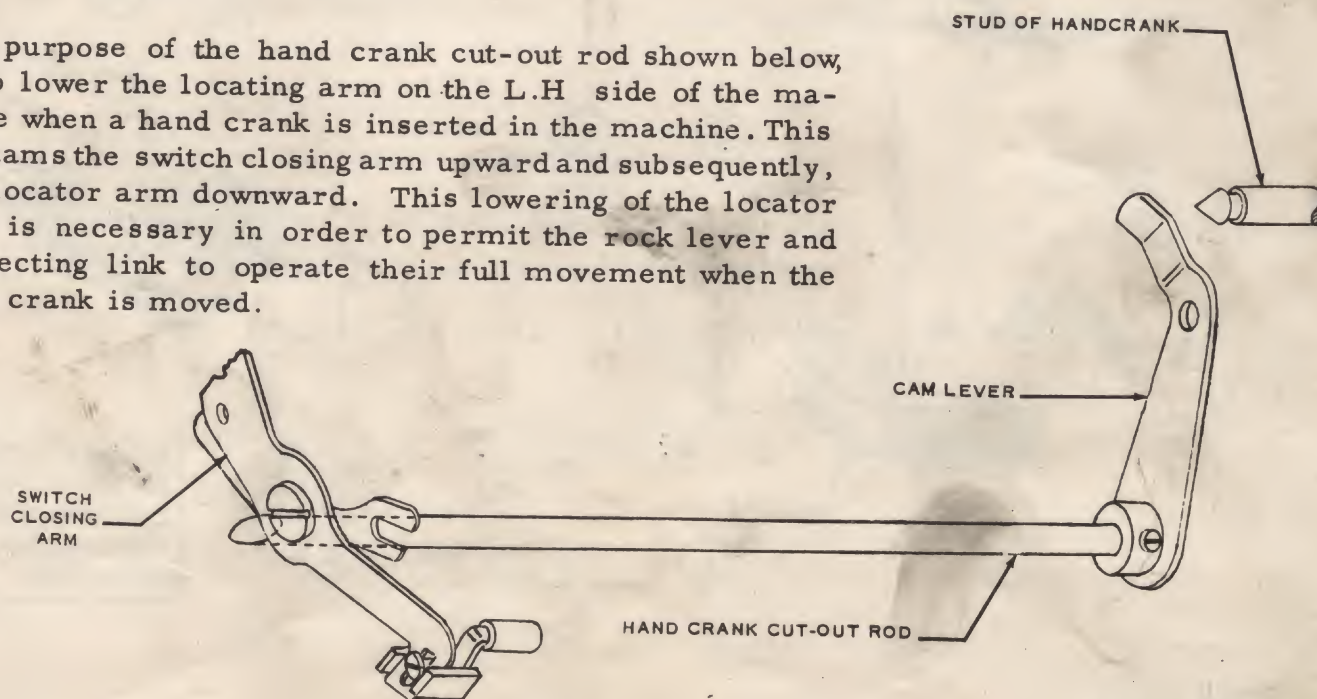
DIVORCING OF PLUS-MINUS KEYS

There are one or more purposes for every part assembled
in our machines. The purpose of many parts is quickly
recognized especially those that are readily visible in
action, but there are some that require explanation. This
is true of the operating arm for the release latch shown
below. Some factory persons have referred to this part
as the DUCK because of its appearance and its bobbing
action. When the duck lowers his head his tail raises and
permits a coupling of the plus and minus keys to the clutch
yoke and machine stopping lever. When the duck's head
is raised by the cycle stop arm, its tail engages arm (E)
of the release latch and accordingly divorces the plus and
minus keys from the clutch yoke and machine stopping
lever.

A stud (B) on this operating arm (DUCK), fits into a hole
in the L.H. side frame and serves as a pivot for the arm.
A large stud (C) on the cycle stop arm holds the arm (A),
against the side frame. When (G) is latched in yoke posi-
tioner (F), slight clearance should exist between (D) and
(E). To obtain this clearance, holds (G) firmly and bend
(E) downward slightly.

CYCLE
STOP ARM

(D) (G) — PLUS-MINUS
          RELEASE LATCH

ZONING
STUD (C)

(F) — CLUTCH YOKE
      POSITIONER

PIVOT
STUD (B)

(E) (A) OPERATING ARM
          FOR RELEASE LATCH (A)

SEE PAGE 4-D FOR
DETAILS OF THIS
POSITIONER AND
THE PLUS-MINUS
KEYS ACTION.

STUDENT _____ BRANCH _____ DATE _____

ORANGE EXAMINER _____ RIGHT _____ WRONG _____

1. Q. What is meant by "carriage setting"?

   A.

2. Q. What part controls the locking action of the carriage locks?

   A.

3. Q. How many adjustable parts are available for setting a carriage?

   A.

4. Q. How can a faster wedge depression be obtained?

   A.

5. Q. What purpose is served by the stud on the bumper bracket shown on page 1-M?

   A.

6. Q. Name the limiting devices that control the movement of the cycle stop arm (1) toward the front of the machine and (2) toward the rear of the machine?

   A.

7. Q. What two methods can be used to raise (trip) the flexible end of the trip lever?

    A.

8. Q. The offset on the upper part of the quick stroke latch serves what two purposes?

    A.

9. Q. When the cycle stop arm is located against the bumper, is the clutch yoke in plus position or minus position?

    A.

10. Q. From plus and minus keys operation, what part actually moves the clutch yoke into position?

    A.

11. Q. There are two engaging studs on the clutch yoke. One faces outward and one faces inward. Describe the purpose of these studs starting with the inner stud?

    A.

12. Q. The trip lever can be adjusted to the cycle stop arm by two adjustments. Can you describe them?

    A.

STUDENT _____ BRANCH _____ DATE _____

ORANGE EXAMINER _____ RIGHT _____ WRONG _____

13. Q. How does the cycle stop arm limit the movement of the clutch yoke?

A.

14. Q. How is the clutch yoke neutralized?

A.

15. Q. How can the roller of the clutch yoke position holding arm be set to the notches of the clutch yoke?

A.

16. Q. Is the stop bracket (Figure 23) adjustable? If so, why?

A.

17. Q. What adjustments are provided for proper engagement of the clutch yoke operating arm?

A.

18. Q. Would it be correct to say that the division lever controls the latching of the shift coupling latch arm with the shift driving lever?

A.

19. Q. If a bind occurs in the automatic shift slide, how would it reveal itself in the performance of the machine during automatic division?

A.

20. Q. If a carriage shifts sluggishly (although RPM is correct), what adjustment would you check first?

A.

21. Q. If the carriage is located one place from "home" position, will the division lever restore automatically? Why?

A.

22. Q. What purpose does the "operating arm for release latch" serve? Why do some factory people refer to it as "the duck"?

A.

TO THE STUDENT

You may have wondered how LA-5 and LA-7 machines are used in business and industry and what figure-work they are capable of performing for the many persons who operate them. It is of value to you to know what these machines are capable of inasmuch as one of the first requisites upon answering a service call is to determine what type of figurework was in process when the machine failure or error occurred. Listed below are some of the various mediums of business arithmetic performed on LA-5, LA-6, and LA-7 machines. It should be apparent that these 'LA' models, though compact in size, are capable of processing all phases of figurework and therefore should receive your full attention during your training period.

ADDITION	SUBTRACTION	MULTIPLICATION	DIVISION
Complements	Constants	Accumulative	Simultaneous
Constants	Series Reduction	Adjacent Figure	Mult (neg. & Pos.)
Cross footing		Short Cut	Build up methods
Decimals		Constant	Constant divisor
Double Keyboard Set up		Decimals	Complementary Decimals
Fractions		Double	
Normal		Negative	
Percentages		Shortcut	
		Simple	
		Three factor	

COMPLEMENTS	CONVERSION	BANKING	DISCOUNTING

RECIPROCALS	PRORATING	SQUARE ROOT

Now that you have completed Book Number 2 of the Service Training Course, you should be well acquainted with the mechanism of the 'L' line of machines. It is our suggestion that you continue your study of automatic 'L' calculators at every opportunity inasmuch as there is still much to be learned of these wonderful machines. To assist you in the pursuit of further knowledge, we are listing herewith a set of questions which should prove thought-provoking and helpful. To find the answers to these questions and others that may arise, we suggest that you study an LA-5 or LA-7 machine carefully and discuss each questionable item with your instructor. If you know the answers to these and prior questions, you will be eligible for the MA-7 training course which will be released in Book No. 3.

QUESTIONS

1   What are check pawls and where are they used?

2   Why are timing dots used on the R. H. side gear train?

3   What is the purpose of the brakes on the selecting shaft cams?

4   Why is there a flat surface cut into the hub of the second gear from the front on the R. H. gear train?

5   What does the check spring check?   Why?

6   The 2127 retainer used on keyboard keystems has the appearance of a 'liberty bell' when inverted. What is its second purpose in addition to retaining the spring thrust-washer?

7   What value does the little arrow serve that is stamped into the keyboard plate near the R. H. carriage lock?

8   Why does the extreme L. H. main shaft arm #2806 have a section clipped off?

9   Why is a knurled cap used on the L. H. end of the selecting shaft?

10   A long stud with a flat surface is used below the eccentric of the yoke position holding arm. Why do you think it is provided and how would you adjust it?

11   Supposing the notch in the rearmost end of the switch closing arm does not align with the clutch yoke stud when the yoke is in neutral. What would be the best way to correct this situation?

12   When the L. H. carriage lock is raised, the digit keys of the keyboard cannot be depressed. Is this desirable?   Why does it occur?

13   What purpose does the resistor serve?

14   What purpose does the condenser serve?

15   The design of the LA-7 permits a true count of items in excess of nine (9) while the machine is operating in addition or subtraction. This item count is of value due to the inability of the upper dials (of the L line) to carry-over. Explain this secondary item count and describe the mechanism that makes it possible.

16   When is the carriage shift knob used that is located on the right of the carriage?

17   What is meant by the Monroe Formula for decimals? Could a weak or missing decimal marker spring prove serious to a user of our LA-5 and LA-7 machines?